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Mariners Weather Log

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Cover: The charred remains of a lifeboat vividly illustrate the tragic collision of the KEYTRADER and BAUNE on the Mississippi. See the item "Fog, fire, foam, ferries, oil, barges, and a river," on page 246 of this issue, for details. U.S. Coast Guard Photo.

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Mariners Weather Log

SEA ICE

Part 3 – Ice Distribution and Forecast Services, Eurasian Waters

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Editor's Note: This article on sea ice has been presented in a three-part series. Part 1 included background, history, and the major features and physical properties; it appeared in Vol. 17, No. 3. Part 2 was a discussion of sea ice distribution and forecast services in North American waters; it appeared in Vol. 17, No. 6, of the Mariners Weather Log. Part 3 is a discussion of sea ice distribution and forecast services in Eurasian waters.

The Eurasian arctic seas of the Northern Hemisphere vary in character from those of the North American Arctic in several major respects. Economically and geographically, the motivation for utilizing these seas is great. The large, major river systems that characterize the Eurasian Arctic have been used increasingly for many decades to transport valuable forestry, mineral, and agricultural resources over thousands of miles from the Eurasian temperate zone heartlands to the ice-covered arctic marginal seas. Thus, the much lower transportation costs afforded by barges and ships can be utilized to deliver materials to domestic and foreign markets. Some of the specific resources so carried include energy in the form of natural gas, coal, peat, and oil shale, as well as petroleum, which is becoming more important for a worldwide solution of the energy crisis. For some time, major pipelines have been under construction or planned in the Soviet Arctic, similar to the Trans-Alaska Pipeline presently under construction. Seven to eight times the amount of proven oil reserve in Alaska--10 billion barrels--are estimated by some Soviet geologists.

Natural gas finds, most of them just south of the Kara Sea, are even more impressive and have led to the building of 48-in pipelines, terminating in the Moscow-Leningrad area. Late in this decade, present Soviet plans call for larger lines, to 100 in. From these, gas will be fed to more remote terminals in the Baltic, the Urals, and the Ukraine. Present estimates of proven Soviet gas reserves on arctic land are believed conservatively to exceed 500 trillion cubic ft; a like amount is anticipated offshore. The total available reserve estimates may ultimately reach a 2 to 3 quadrillion cubic ft range. In all, the 39,000 mi of gas pipeline presently carrying natural gas from the remote Soviet areas should greatly increase, and pipeline mileage from western Siberia should double by 1975.

Metals and minerals transported to Europe and Asia from this region include iron/steel, aluminum, gold, mica, apatite, copper, nickel, platinum, and cobalt. Diamonds mined in the Soviet north, as well as fertilizers and other chemicals, are also thus shipped. Furthermore, industrial, forestry, and agricultural products are transported from as far south as the central Eurasian heartlands paralleling the Trans-Siberian Railroad via the river routes to the various arctic seaports. Historically, lumber has been most important, and is now diminishing only relative to the many other materials. Soviet river transport is much further developed than that in the United States and, to a lesser extent, in the more advanced European and Asian countries. Hydrofoils and other commercial river transport means are being developed to replace barges. The rivers are kept well dredged and otherwise navigable along their entire length, in some cases.

Northern railroads are not any better developed than those in the North American Arctic. The Soviets have made aircraft an essential auxiliary method of communication and transportation throughout their

northernmost arctic regions.

THE ARCTIC AND ANTARCTIC INSTITUTE OF THE U. S. S. R., LENINGRAD, AND THE NORTHERN SEA ROUTE

In order to extend and further use the combined assets of navigable rivers and ice-covered arctic seas, the U. S. S. R. initially created a Northern Sea Route Directorate, involving research and development applied primarily to ice observations and forecasting. The ice forecasting and research efforts were recently assumed primarily by the Arctic and Antarctic Scientific Research Institute, located in Leningrad. This beautiful institute is perhaps the largest in the world to devote its entire efforts to polar study. It has approximately 1,000 employees, about a third to a half scientists who have completed or are completing graduate study. A considerable number of survey ships and icebreakers are utilized by this organization to assist cargo convoys through the difficult pack ice and conduct supporting oceanographic, ice, and meteorological research programs.

Figure 1.--High Latitude Airborne Expedition (HLAE). Photographed by U. S. Naval Oceanographic Office's BIRDS EYE Flight on April 23, 1965, in the vicinity of 86°10'N, 55°E. Facilities include 3,000-ft runway, nine Colt-type (AN-2) aircraft, five helicopters, and four POL dumps.

The institute is responsible for four types of research platforms which serve in arctic waters. The first of these is a network of land stations, located along the entire coastline of the continent and at strategic positions along the coasts of the five major archipelagoes and islands north of the mainland. The second type of platform is the drifting iceflow research station. The 22d of these was established this past year on a drifting central arctic iceflow north of Ostrov Vrangelya. The first station was occupied in the 1937-38 season, but the program was not continued as a regular year-round activity until 1951. The lifespan of an iceflow station is between 3 and 4 yr. The station program contributes to many scientific disciplines, but most important from the shipping and navigation season extension viewpoint is a better understanding of the highly variable daily weather over the sparsely covered central Arctic Ocean and the contribution or advection of Arctic Basin ice to the individual marginal seas. The details of such drift will be considered below. The third platform concept is the Soviet High Latitude Airborne Expeditions (HLAE)(fig. 1), begun in 1932. These have continued (with a few exceptions during World War II) on an annual basis. An idea of the magnitude of these annual efforts can be acquired from accounts and photographs, one of which revealed some 170 buildings, 200 personnel, 9 fixed wing aircraft, and 5 heavy-duty helicopters. These expeditions are generally mounted in March and/or April. The aircraft (fig. 2) are equipped and modified as flying laboratories for studying air-ice-ocean energy interchange on a quasi-synoptic basis, over large portions of the Arctic Basin. The logistical efforts required by these HLAE's are frequently combined to establish new drifting stations and deactivate those which are endangered or no longer needed for scientific coverage. A fourth platform is the drifting automatic radio-meteorological station or DARMS. Considerable meteorological information, such as wind speed and direction, air and water temperature, atmospheric pressure, ice drift speed and direction, and current velocity data, are provided by DARMS. The deployment and retrieval of the DARMS takes place on a major scale during the annual HLAE activities.

The Soviet Arctic Institute is headed by the widely known polar explorer and scientist, A. F. Treshnikov. The Institute has recently described the basic methodology developed for long-range ice reconnaissance. In addition to routine oceanographic and meteorological reports, special aerial ice reconnaissance information and, more recently, meteorological satellite data are used as prime input data. The aerial reconnaissance is a broad program with a long history of development; pioneering ice reconnaissance flights go back to the 1930's. Details of the expansion of this service are fragmentary, but can be gleaned from data in-

Figure 2.--It looks like a "white out" at this Russian HLAE base. The reconnaissance aircraft operate under extremely difficult conditions.

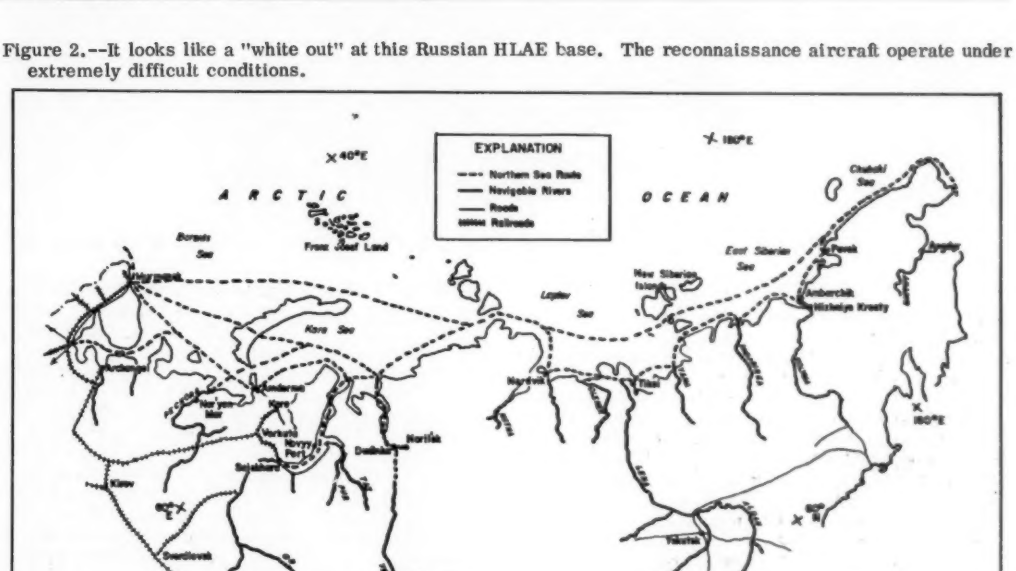

Figure 3.--Major U.S.S.R. Arctic surface routes. Courtesy of the Arctic Institute of North America.

cluded in the prolific Soviet scientific papers on ice distribution, causes, and prediction. The National Science Foundation has recently undertaken a national program of translating the more significant Soviet periodicals.

The optimum routes north of the Soviet mainland, extending over 4,000 mi from the Atlantic (Greenland Sea) to the Pacific (Bering Sea)(fig. 3), are collectively

Figure 4.--World's first nuclear-powered icebreaker, the LENIN, helps keep the Northern Sea Route open.

known as the Northern Sea Route. The exact route differs each year because of the widely varying ice severity. It generally proceeds eastward from the city of Murmansk and the White Sea ports--the best known being Arkhangel'sk--through the Proliv Karaskiye Vorota, which separates the Barents and Kara Seas south of Novaya Zemlya. Continuing eastward through the Kara Sea, the route generally extends north of Ostrov Belyy to the major Soviet port of Dikson and beyond to the Proliv Vik'kitskogo. These straits separate the Kara from the Laptev Sea south of Severnaya Zemlya. The northern sea route then continues eastward to the numerous ports at the mouths of the Khatanga, Lena, Anabar, and Yana Rivers. Of all Soviet ports in the Laptev Sea, Tiksi is perhaps the best known. Further eastward, the Proliv Dmitriya Lapteva must be negotiated before entering the East Siberian Sea. This sea is less sheltered by major archipelagos from the central arctic pack than any of the aforementioned Soviet seas. Fortunately, the major wind and ice drift carries ice away from the coastal regions during the general June-October navigation season. Pevek is probably the best known port in this sea. Finally, in proceeding eastward, shipping would have to pass through the Proliv Longa before reaching the Chuckchi Sea and Bering Strait. Mys Schmidt is the best known port in the Soviet portion of the Chuckchi Sea. It serves as a staging area for convoys proceeding westward and, in light ice years, as a convoy disbanding area for ships bound for the open Bering Sea and Pacific Ocean. Anadyr, on the Anadyrskiy Zaliv (gulf) of the Bering Sea, is the easternmost port on the Northern Sea Route.

Although attempts to extend the Northern Sea Route season occasionally are reported in news bulletins, an average navigation season is about 150 days, with wide annual variability. This may change when two nuclear-powered icebreakers are brought into service after 1975. Currently, the nuclear-powered icebreaker LENIN (fig. 4) is assigned to the Northern Sea Route and will soon be joined by the recently completed YERMAK (fig. 5). Freight traffic through the passage is believed to be increasing, averaging almost 2 million metric tons. The number of ships involved in this traffic could be as high as 300, according to 1970 Canadian estimates. Ships may make two or three trips in a single year, depending on their destinations and routing. The most frequently traveled section of the route appears to be the Atlantic side, from the Kara Sea ports to Murmansk.

ICE DISTRIBUTION IN EURASIAN MARGINAL SEAS

BARENTS SEA

The Barents Sea has the least severe ice conditions of all Northern Sea Route regimes, and it is extremely important as a marginal arctic sea. Murmansk and

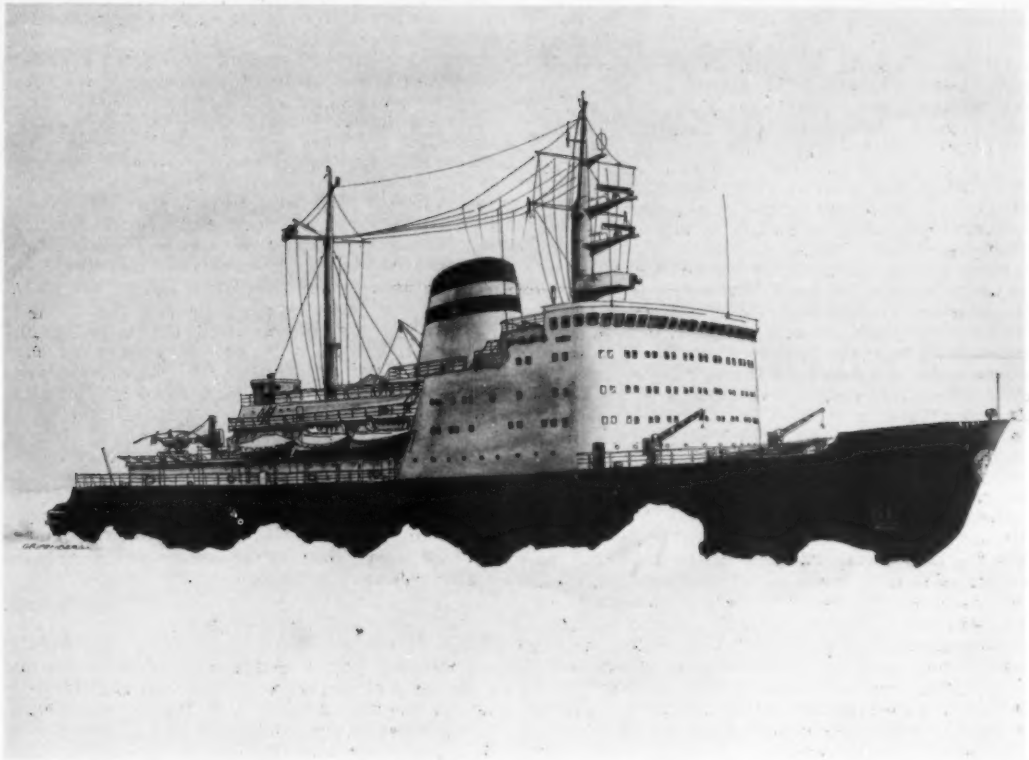

Figure 5.--Artist's conception of the new Russian icebreaker YERMAK, just completed at Helsinki, Finland.

its adjacent seaports serve as the Atlantic Ocean terminal. The Belaye More or White Sea, containing the very important arctic port Archangel, is located just to the south. Murmansk and Arkhangel'sk are the two largest arctic ports of the Northern Sea Route, and, indeed, of the entire arctic Northern Hemisphere. Two submarine bases of one of the four major Soviet fleets, the Northern Fleet, are located close to Murmansk. The ice cover here is local and somewhat similar to lake ice conditions, and, in the late December to March period, widely variable climatic conditions create sporadic ice problems. However, Soviet icebreakers have been able to keep this port, together with its approaches, open, even during the ice cover season. Thicknesses attained are between 24 and 30 in; multiyear or glacial ice is not a problem, as in the other major seas.

The bathymetry in the White Sea approaches varies between 36 and 60 m before the deeper waters of the mainland-paralleling route are reached. In the mainland area, depths of 70 m are characteristic, although the shoaling is rapid toward the coast and the Novaya Zemlya coastline to the north. In the Barents Sea, depths of several hundred fathoms are the rule when one steams a couple hundred miles westward of Novaya Zemlya, except for large, shallower shelf regions of 50 to 120 m, which lie along lines midway between Zemlya Frantsa Iosifa and the Kola Peninsula on one axis and between Spitzbergen and Novaya Zemlya on an axis perpendicular to the first. Ocean current and ice circulations near the mainland coasts are predominantly offshore, from north to south.

Ice conditions north of the mainland usually permit navigation by mid-June. The Pechora River and its major port, Nav'yan Mar, can then be reached until freezeup in late October. First-year ice may be 50 in thick at its most severe northeast extremity, in the coastal vicinities of Novaya Zemlya. South of 75°N, the ice is generally fractured into belts and strings by winds and wave erosion; little multiyear ice is advected into the sea except along the east coast of Zemlya Frantsa Iosifa and between Frantsa Iosifa and Svalbard.

KARA SEA

This sea is very shallow, with depths generally 50 m or less within 50 to 100 mi of the mainland. To a limited degree, it is bounded and protected from incursions of multiyear ice by Novaya Zemlya on the west and, to the north, by Zemlya Frantsa Iosifa. Similar protection from multiyear ice incursions is afforded by Severnaya Zemlya on the northeast. A wide trough, with depths of 245 to 360 m, parallels

Novaya Zemlya along its entire length, near the westernmost portion of the sea. Many rivers empty into this sea, and the Kara contains more isolated small islands along its mainland shore than other Soviet marginal seas. The general circulation of surface waters and ice in the sea is cyclonic. Southward-flowing currents carrying multiyear ice are characteristic east of Novaya Zemlya; relatively warm, ice-free, northward-flowing currents characterize the Kara Sea coastal waters west of Severnya Zemlya. The magnitude of these currents may reach 1/2 kt in summer, and, when intensified by storms, it may briefly reach over 1 kt.

Ships are able to transit the Northern Sea Route in the Kara, Barents, and Laptev Seas primarily because of the wind circulation. The predominant winds are from the south, although frequent cyclones pass eastward through the sea, sporadically reinforcing the cyclonic circulation. Overwhelmingly, an offshore component exists in the isobaric patterns, characterizing mean surface atmospheric circulation, except for Severnaya Zemlya, for all months of the year. As a result, intrusions of multiyear ice and growth of very thick and highly deformed winter ice are minimized. These conditions also produce flaw leads or leads off the shore-fast ice along the mainland and Novaya Zemlya coasts, during winter as well as during the navigation season. On the other hand, a characteristic storm track, usually weak to moderate, lies parallel to the coast, in the middle of the Kara and the adjacent Barents and Laptev Seas. Sporadic storms cause intrusions of multiyear ice, which tend to hinder shipping along the eastern coasts of Novaya Zemlya and Zemlya Frantsa Iosifa. Cold, southward-flowing currents tend to be reinforced by the southward movement of multiyear ice occurring with the eastward-moving cyclones.

First-year ice tends to predominate in the Kara Sea. New ice generally starts to form in the normally ice-free sea in middle to late September. This initial formation may, in unusually severe years, occur as early as September 6; in unusually light years, initial formation may not take place until late October. The maximum growth averages about 69-in, ranging from 57 to 75 in. It usually occurs during the last week in June, but, in severe years, the maximum growth may continue into early July. Regionally, the location of the severe ice depends on past surface wind flow patterns. Melting of the ice takes place rather rapidly and is hastened by southerly winds. A complete disintegration of first-year ice occurs from late July through the first half of August. Factors that affect the dates of complete melting are low air temperatures, the presence of unusual amounts of multiyear ice, and unusual surface wind circulation patterns. Even the multiyear ice is completely disintegrated by mid-July to mid-September. During September and October, in addition to increasing ice cover and thickness, severe storms can make loading and extension of the navigation season difficult, with low visibilities, high wind chill indexes, choppy seas, and superstructure icing. Although Severnaya Zemlya, Novaya Zemlya, and Zemlya Frantsa Iosifa all have some glaciation, the shallow depths off these land masses tend to make observations of glacial ice extremely rare in this sea. It should be emphasized that, in the Kara Sea, the contributions of relatively warm waters in summer, by its five major river systems, tend to assist in the breakup and/or weakening of the ice.

Even a superficial treatment of ice and navigation conditions in this sector of the Northern Sea Route should emphasize the "pressure points," or areas of special difficulty. These areas are the narrow straits connecting the Kara with its adjacent seas. The Proliv Karskiye Vorota tends to become severely congested during the unusual but sometimes persistent southward incursions of multiyear and other types of ice. At such times, the narrow strait south of Ostrov Baigech may be utilized. In cases where both straits are covered with severely deformed ice under pressure or where very deep draft vessels require it, convoys may follow a longer route through Matochin Shar or even north of Novaya Zemlya, in the vicinity of Mys Zhelaniya. At the opposite, eastern end of the Kara, the Proliv Vil'kitskogo and Proliv Shokabskogo present very similar congestions and delays for ships passing between the Kara and Laptev Seas. Here, too, the northerly route above northern Severnaya Zemlya can be followed. Resorting to such northern routes, especially the latter, obviously endangers convoys to incursions of multiyear polar pack ice upon the northern coast of the archipelagoes. The increasing use of these routes is a result of advances in ice prediction capability, as well as improvement in the design and power of icebreakers.

LAPTEV SEA

The Laptev Sea also contains the northern terminal ports of five major river systems originating in central Siberia. In addition to Tiksi near the Lena, Starorybnoye, at the mouth of the Khatanga, and Uedey, near the mouth of the Yana, are among the major ports of this sea.

Like the Kara, the inner portions of the Laptev are frequently very shallow, with soundings of 35 m or less. Coastal areas in the vicinity of the ports mentioned and the eastern extremities of the sea are even more shallow, with 18-m soundings. The Laptev Sea is much less protected than the Kara from north-to-south incursions of multiyear ice. These can occur when the predominant offshore flow is interrupted by occasional severe cyclones moving from west to east and northeast through this region. Considerably fewer small islands occur along the mainland and in the northern extremities of this sea than in the Kara.

The current and circulatory patterns of the Laptev are very similar to those of the Kara, with cyclonic circulation predominating. The rivers greatly affect the coastal oceanographic conditions in summer with their contribution of warm, low-salinity water. An ameliorating effect is produced on the ice regime by these rivers, as in the Kara and East Siberian Seas, because of the spring freshet which occurs in May. The air temperature overland rises abruptly above the melting point, and the considerable snow cover characteristic of the northern Siberian coast is rather suddenly subject to melting temperatures. This tends to widen and increase the size of flaw leads. Over a period of weeks, the fast ice tends to erode quickly, partly because of the freshet, resulting in the swift

disintegration of shore-fast ice. By early June (usually prior to the onset of the shipping season), the fast ice is completely disintegrated. This situation tends to make wind drift a more determining element in the navigation season.

Because of the predominant first-year ice, new ice in the Laptev tends to form in an open sea in the last week or two of September. During mild seasons, this may be delayed until early or even mid-October. Ice after November tends to grow at a steady rate, reaching a maximum of approximately 74 in, generally by June 5 to 20. This maximum varies from 65 in in mild years to 78 in in severe years. The maximum growth may be reached in late May, though the ice may grow until the middle of June in severe years. After maximum growth is reached, the melting cycle begins. This cycle occurs much more quickly than the growth. By late July or early August, complete melt of the first year ice occurs, in both severe and light ice years. Several weeks later, ice-free conditions prevail, interrupted in some seasons by multiyear ice incursions.

Multiyear ice incursions in the Laptev Sea are the exception rather than the rule, though favored by fewer protective land masses to the north. This is due to a predominant offshore component that occurs in the prevailing winds. As a result, navigation is usually possible from mid-July to middle or late October. Increasing sophistication in icebreakers, convoy techniques, and ice prediction will further extend the season.

The pressure point of Proliv Vil'kitskogo, at the western extremity, has already been discussed. Severe congestion may occur at the eastern extremity, also, where the alternative straits Dmitriya Lapteva and Sannikova may require, on rare occasions, a circumnavigation to the north of Novosibirskiye Ostrova.

EAST SIBERIAN SEA

The East Siberian Sea is somewhat similar to the Laptev and Kara Seas, since it is fed by three major river systems and a myriad of lesser ones. The difference is that the source region of these rivers is much less of an industrial region. Nonetheless, considerable oil and minerals are carried to such major ports as Chokurdakh, Cherskiy, and Pevek. The latter is considered a termination port, where convoys are staged and dismantled at the beginning and end of the navigation seasons (fig. 6).

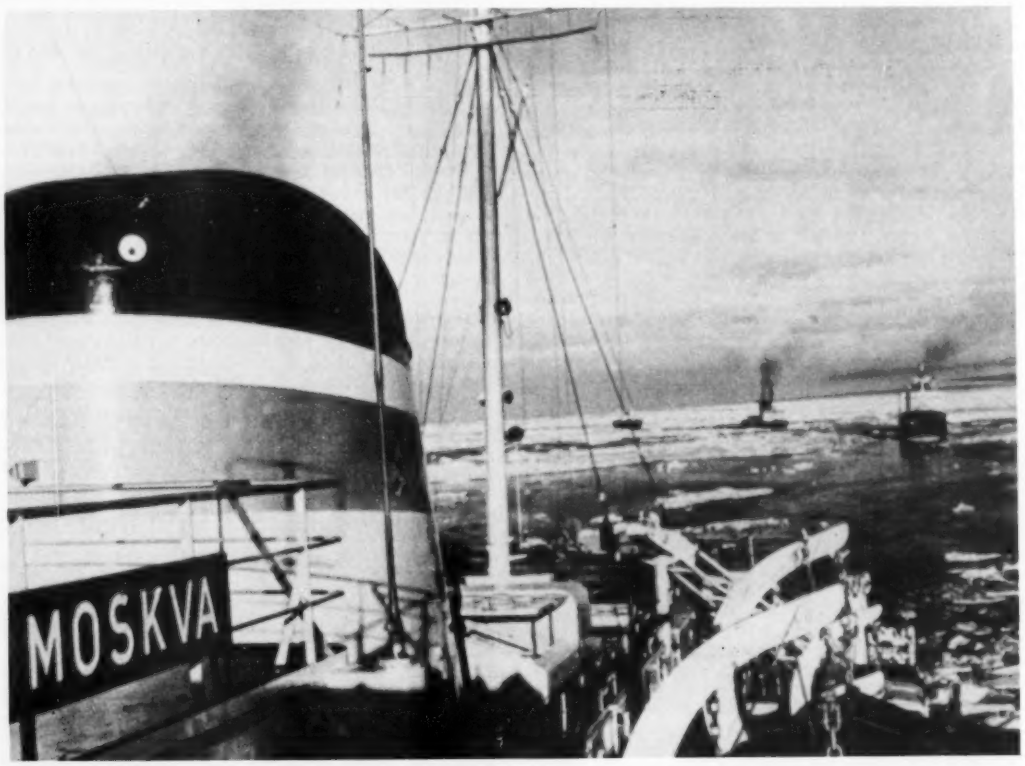

Figure 6. -- MOSKVA leads convoy through relatively "easy-going" ice along the Northern Sea Route.

Figure 7.--Very High Resolution Radiometer (VHRR) NOAA-3 picture of the East Siberian Sea, taken April 8, 1974. Coast is completely covered by fast ice.

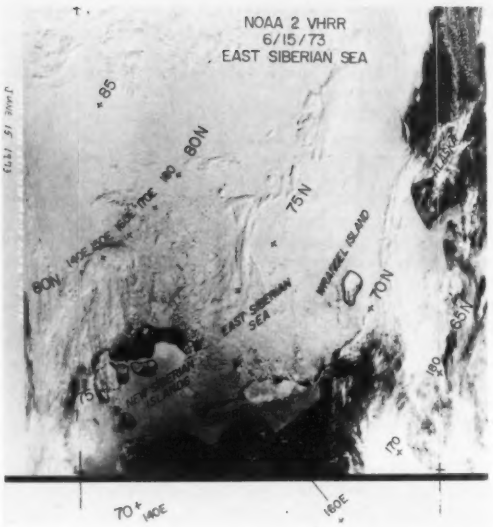

Figure 8.--NOAA-2 VHRR picture taken on June 15, 1973, shows the same area as the previous figure. Note the long lead that appears north of the Siberian coast and the open water north of the New Siberian Islands.

Currents are somewhat less regular than those of the other Soviet marginal seas, with west-to-east motion predominating along the coastal region. A self-contained cyclonic circulation is located in the east-central sector of the sea, and variable conditions occur in the very shallow waters surrounding Novosiberskiye Ostrova. As a result of this shallow character and the unparalleled extent of the shelf surrounding the islands, the area has been referred to as the "fast ice sector." Here, fast ice grows from the shore seaward for several hundred miles, an extent unprecedented anywhere in the Arctic. Only in some of the more remote areas of the Canadian Archipelago are similar but less extensive conditions for fast ice found.

Another distinctive feature of the East Siberian Sea is the wind and atmospheric pressure pattern. In place of the offshore drift characteristic of the seas to the west, the dominant characteristic here is a "col" condition. That is, at the northern extremity of the sea, the heavy multiyear ice usually circulates from east to west, with a weak offshore component. Along the immediate mainland coastal sector, on the other hand, west-to-east flow predominates, as a result of a quasi-permanent high-pressure cell to the south. The East Siberian Sea is even less shielded by protective islands and shoal regions in its wider northern extremities than the Laptev Sea. Fortunately, fewer anomalous north-to-south wind stress conditions are experienced here. Incursions of severe multiyear ice are less likely during the navigation season, when convoys could be beset by such incursions and driven onto the coastal shoals.

The predominant first-year ice begins to form in the East Siberian Sea about September 20, but may be delayed until the first part of October. Growth proceeds at an accelerated rate by November, and maximum thickness of 65 to 75 in is attained approximately by June 10. Seasonal variability (figs. 7 and 8) results in maximum thickness occurring between May 27 to June 15, ranging between 60 and 78 in. Complete melt of the first-year ice normally occurs in early August, and rarely are considerable quantities left in the sea after August 15. On the rare occasion when incursions of multiyear ice do occur, navigation is severely hampered as late as the first weeks of September. Such difficult ice conditions usually result from intensified persistent north-to-south wind components in July through September, which carry considerable quantities of multiyear ice directly across the shipping routes and into the harbor and port regions.

The surrounding shoals prevent all but relatively small icebergs from Novosiberskiye Ostrova from reaching the shipping lanes. This danger occurs only once in every 7 yr or so.

SOVIET PORTION OF THE CHUCKCHI SEA

This region is much more familiar to the North American community from U. S. and Canadian experience with Alaska coastal shipping and scientific activities. It is somewhat deeper than the other Eurasian marginal seas: 40 to 60 m depths predominate beyond 10 mi from the coast. Currents are weak, as in the East Siberian Sea, and, near the coast, tend to flow southeastward to the Bering Sea. In the northern extremities, both currents and winds take on a southerly component and tend to cause a current flow toward the north and west. The result is an overall counterclockwise circulation.

The mountainous terrain to the south of the coastline tends to make the rivers shorter and less important from an economic and transportation viewpoint. The important ports here are Mys Schmidt and Billings, both in the eastern extremity of the region. These ports become especially important when ice conditions are severe in the Chuckchi Sea and to the west. Then they are used for organizing convoys early in the navigation season and for dismantling convoys near the end of the season.

Glacial ice is almost completely absent from these waters, except for shelf ice fragments that occasionally drift from the waters adjacent to the western Canadian Archipelago. These ice fragments, usually broken into pieces less than a mile in diameter, occur only with unusual northeasterly wind flows.

The predominant first-year ice generally starts to form early in September. Near the Bering Strait and in the vicinity of Mys Dezhneva, the initial formation is delayed until October 14 because of warmer air and water conditions. Sea ice grows sporadically until about a month after initial formation, and then attains a steady growth rate. A maximum annual thickness of 66 in is normally reached in the western extremity of the sea. In the vicinity of the Bering Strait, a thickness of approximately 55 in is normal. In both regions, this maximum occurs in the first week of June. Because of seasonal fluctuations, a much greater range is experienced in the Bering Sea sectors, from 46 in in a mild season to 62 in in severe seasons. In the approaches to the East Siberian Sea, the range of thickness attained during abnormal seasons is from 61 to 71 in. The melt cycle varies, with complete melt usually occurring after mid-June near the Bering Strait, but not until late July or mid-August near the entrance to the East Siberian Sea, where August 11 is the normal date of complete melt.

This sea does not have congestive problems in the western strait because of the distance between Ostrov Vrangelya and the mainland.

SOVIET PORTION OF THE BERING SEA

Below the Bering Strait, at latitude 66°N, some ice exists over portions of the Bering Sea all the way south to the Hokkaido Island coast of Japan, at about 43°N. However, this ice is confined to a narrow coastal strip 16 mi wide, south of 55°N, off the Polvostrov Kamchatka and Kurilskie Ostrova. Here, the composition of the ice is usually broken strings and belts of block and brash. The coastal ice occurs under the influence of the cold, southward-flowing Oyashio Current system. Rarely does it occur south of 55°N before mid-December; equally rare are occurrences after mid-March. East of northern Kamchatka and north of 55°N, the width of the Bering Sea ice cover increases considerably, and, at approximately 60°N, the ice edge turns eastward at the time of maximum coverage and thickness--late March or early April. There is some tendency for the ice to be somewhat thinner, less concentrated, and for the edge to turn northward to the approximate position of the International Date Line in this period; further to the east, it trends toward the south again. Maximum first-year ice thicknesses are 14 in or so, near the southern edge; it increases gradually to about 50 in, on the average, near the Bering Strait. No multiyear ice occurs south of the Bering Strait. Frequently, severe winds cause ridges with total thickness of up to 65 ft near the Bering Strait. Near the southern edge, extreme fragmentation of the iceflows occurs. Icebreakers have reported swells, associated with severe gales crossing the Aleutian chain, reaching as far as 50 mi inside the pack ice edge. Such swells may well be the major cause of this marginal sea ice fragmentation.

By May, the ice boundary in the central Bering Sea approximates 65.5°N. By early June, it has a northeast to southwest orientation, from the Bering Strait to Mys Navarin, at about 62.5°N on the Soviet coast. During the latter half of June, all waters south of the Bering Strait become ice free.

In the Anadyrskiy Zaliv, Anadyr is a major port. It probably rivals Vladivostok, far to the south, as the Pacific terminus of the Northern Sea Route.

SEA OF OKHOTSK

In the Sea of Okhotsk, interest in sea ice distribution and behavior is shared by the Japanese and the Soviets. The Japanese Hydrographic Office is involved in a limited ice reconnaissance program. Their scientific interest in sea ice is related to the leadership in commercial fisheries enjoyed by the Japanese. In addition to the Hydrographic Office's ice reconnaissance program, Japanese scientists at the Institute of Low Temperature Sciences, Hokkaido University, near Sapporo, Japan, conduct a vigorous research program in all phases of ice physics, dynamics, and behavior. Knowledge acquired at their field stations is published, and much is translated into English, Russian, and other languages and applied in sea ice areas at both poles. Recently, Hokkaido University scientists have trained several fixed land station radars upon sea ice, acquired radar scope photographs, and run the resultant imagery frames off at fast speeds. These time-lapse films (fig. 9) give remarkable insight into the many complex motions of the pack ice in the Sea of Okhotsk, under the influence of tides, ocean currents, and wind stress.

Figure 9.--Radar picks up drift ice in the Okhotsk Sea off northern Hokkaido on March 14, 1969, at 0900. Photo courtesy of National Research Council, Reykjavik.

Since sea ice in this basin is generally subject to complete summer disintegration, all sea ice is first-year ice, with moderate amounts of fast ice and large amounts of drift ice. In general, the growth and movement are in response to the counterclockwise current circulation within the sea. However, ice forms earlier and lasts longer in Tatar Strait and to the north, where pressure ice may reach a height of 25 ft. Ice first forms in mid-October near freshwater outflows, especially in the north and northwest. As the ice season progresses, ice spreads rapidly, and large quantities drift southward. Although ice forms on the west coast of the Kamchatka Peninsula, wind and wave action permit currents to distribute it as drift ice northward and westward in the sea. Ice from the northern Sea of Okhotsk drifts southward along the east coast of Sakhalin in December, generally reaching Hokkaido in mid-January and remaining until April. Sea ice may be found in varying concentrations throughout all except the southeastern part of the sea until April. From April through June, disintegration progresses northward and northwestward, and finally southward along the coast of Sakhalin. Except along the coasts, in the northern pack, and to the north and west of Tatar Strait, concentrations generally remain near 4/8 during the ice season. As in all marginal seas of the Eurasian Arctic, considerable variability occurs from year to year.

BALTIC SEA, GULF OF BOTHNIA, AND ADJACENT WATERS

The Baltic is a Mediterranean-type sea, unconnected with the Arctic Basin. It has an area of about 120,000 sq mi, about one-half of which becomes ice-covered during ordinary winters. It is connected to the North Sea, and thus to the North Atlantic, through the essentially ice-free channels of the Skagerrak and the Kattegat. Clearing completely of ice each year, it is altogether dominated by first-year ice types. The number of ships entering and/or clearing this sea in a single day sometimes exceeds the total number using the North American or the Northern Sea Route in an entire year. Ships entering and clearing Swedish and Finnish ports alone exceeded 10,000 in a single winter in the late 1950's. Denmark, Finland, Germany, Poland, Sweden, and the U. S. S. R. fringe this sea. Outside of the U. S. S. R. and Denmark, activities and individuals who have contributed significantly to the knowledge of ice distribution and forecast services are briefly commented upon below.

B. Rodhe, of the Swedish Meteorological and Hydrographic Institute in Stockholm, has provided some of the most comprehensive information on sea ice observing and reporting techniques in the Baltic. In an article published in Arctic Sea Ice, by the National Academy of Sciences, National Research Council, in 1955, he describes the Baltic Ice Code approved by most nations bordering the sea and by Norway. Reports utilizing this code are collected, mostly from ships, and disseminated in daily bulletins and special radio and radioteletype broadcasts for shipping.

E. Palosuo, of the Finnish Institute of Marine Research, Helsinki, was instrumental in promoting Baltic cooperation and standardization in ice reporting and observing. He has published widely in a variety of disciplines concerned with ice operations and ship design capabilities, as well as in those sciences associated with air-ice-sea interaction and processes. A complete description of ice in the Baltic appeared in the 1966 Oceanography and Marine Biology Annual Review (Vol. 4, pp. 79-90); oceanographic and meteorological effects and influences are also well covered. Palosuo does not completely confine his interests to the Arctic, and he is usually present at any international conference where science is a major topic.

At the Deutsches Hydrographisches Institut in Hamburg, Federal Republic of Germany, ice bulletins (fig. 10) are regularly issued to Baltic Sea mariners and other interested organizations. The West Germans have also cooperated with Finland in expanding available icebreaker capabilities to Baltic shipping. The Finnish, of course, have been in the forefront of icebreaker design and construction, not only for the Baltic, but for operations in other polar areas as well.

Low salinities in the Baltic Sea result in hard first-year ice, which exists largely as fast ice from October through May. The first sea ice generally forms in the northern Gulf of Bothnia in late October or November, extending along the coasts to the southern Gulf by early to mid-December and along Baltic coasts by late December through January. The southern Baltic, the islands and straits between Denmark and Sweden, the fjord south of Oslo, and portions of coastal Denmark, Germany, and the Netherlands often experience harbor and narrow coastal ice formation in late January and February. In the Gulfs of Bothnia, Finland, and Riga, the ice generally continues to expand through mid-March, with considerable solid ice along wide coastal areas and lesser amounts of free ice throughout the central basins. Ice in the southern Baltic generally occurs only along coastal areas and begins its retreat by mid-March. By April, only the Gulfs of Riga, Finland, and Bothnia have sea ice. The ice melts rapidly in spring, affecting only the northern Gulf of Bothnia by May. The average number of days with ice varies from 0 to 190, with the northern extremity of the Gulf of Bothnia being the coldest and most ice-covered. Pressure ice is common during the ice season along the coasts and throughout the Gulf of Bothnia, where total pressure-ice thicknesses of 6 to 20 ft are not uncommon. Mean maximum thickness of the sea ice varies from less than 1 ft in the west to about 1.5 ft along the Baltic coasts. Ice in the eastern gulfs varies in thickness from 1.5 ft in the south to 3 ft in the north.

BLACK SEA

Although there is considerable variability from year to year, sea ice generally is present in the Black Sea and the Azovskoye More from November through April. With the exception of the Azovskoye More, ice concentrations are generally limited to the peripheral and inlet areas of the northern and western coasts. In recent years, however, there is growing evidence that industrial influences may affect the length and severity of the ice season.

First formation generally occurs in the shallow embayments of the northern Black Sea and Azovskoye More, with the expansion of the Siberian High in middle through late November. Growth continues into February, with maximum concentrations (to 10/10) over the entire area of the Azovskoye More and rapidly decreasing concentrations beyond the shallow, peripheral,

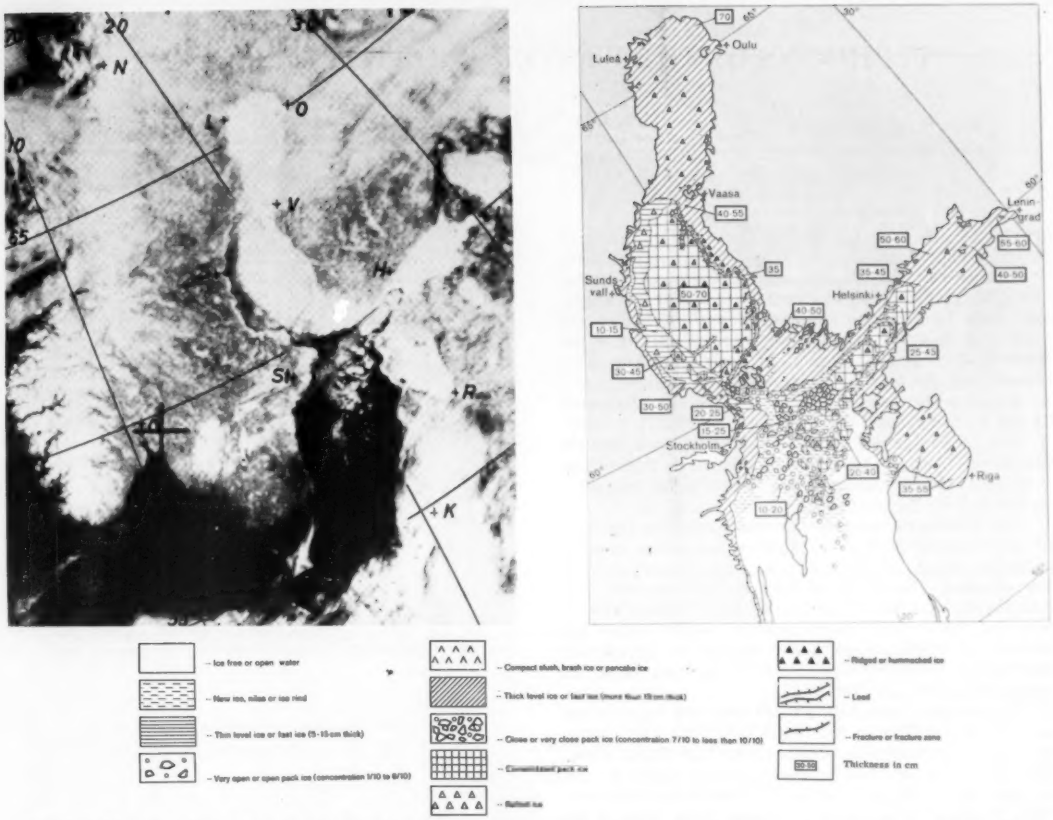
Luleå
Oulu
Vaasa
Lenin grad
Sunds vall
Helsinki
Stockholm
Riga
-- Ice free or open water
-- New ice, slikes or ice rind
-- Thin level ice or fast ice (5-15 cm thick)
-- Very open or open pack ice (concentration 1/10 to 6/10)
-- Compact slush, brash ice or pancake ice
-- Thick level ice or fast ice (more than 15 cm thick)
-- Close or very close pack ice (concentration 7/10 to less than 10/10)
-- Consolidated pack ice
-- Ridged or hummocked ice
-- Lead
-- Fracture or fracture zone
Thickness in cm

Figure 10. --Satellite picture of the Baltic Sea and accompanying ice analysis chart for March 26, 1969. Photo courtesy of Deutsches Hydrographisches Institut.

northern through western Black Sea. Rapid decay of the ice generally starts in February, and most of the ice has disappeared from the Black Sea by March. The shallower embayments of the Azovskoye More generally have decreasing amounts of sea ice into April. In severe years, ice may be a problem for small coastal vessels.

FUTURE OUTLOOK

International cooperation, after the model developed in Antarctica, appears to be a necessary prerequisite to an exponential increase of our understanding of the Arctic Basin ice cover and its interrelationships with ocean and atmosphere. Several promising recent developments have occurred and are planned.

The publication of under-ice data from upward-beamed echo sounders, acquired from the British nuclear-powered HMS DREADNOUGHT in 1971 at an international conference on sea ice in Reykjavik, Iceland, may portend that similar data from U.S. and U.S.S.R. under-ice voyages soon may be forthcoming.

In spite of worldwide austerity, the U.S.-Canadian AIDJEX (Arctic Ice Dynamics Joint Experiment) will proceed, after several pilot experiments, to a full experimental stage in 1975. Untersteiner, a leading U.S. ice dynamicist, and other colleagues have recently conferred in Leningrad with their Soviet counterparts to exchange ideas and discuss cooperation in the broader U.S.S.R. project, POLEX (the Polar Project). The latter is a plan to jointly study both polar regions in depth, in an effort to determine more quantitatively the influence of both on global climate. This program is to be related to the international project GARP (Global Atmospheric Research Project).

A recent assessment of international environmental prediction capabilities, sponsored by a joint Intergovernmental Oceanographic Commission (IOC)/World Meteorological Organization (WMO) planning group for an Integrated Global Ocean Station System (IGOSS), included a review of international sea ice observation, analysis, and prediction capabilities. Murtey of Canada conducted the rather extensive review and compiled the information which should be made available through IOC in the near future.

Rapid progress in the above areas should occur in the remaining 1970's and 1980's. This exciting period should provide many answers to the unanswered scientific questions concerning air-sea-ice interaction, developments in transportation over, through, and under the ice, and, finally, much needed energy resources to fulfill world needs.

TYPHOONS OF THE WESTERN NORTH PACIFIC, 1973

Capt. Charles R. Holliday, USAF
Fleet Weather Central/Joint Typhoon Warning Center
Guam, Mariana Islands

This season was marked by the small number of tropical cyclones that developed over western North Pacific waters and the late start in the year. During 1973, 21 tropical storms formed (5 below average), with only 12 reaching typhoon strength. This equals 1970 and 1950 for the lightest typhoon activity in the modern 29-yr period of record. Only 5 yr have had a lower total number of storms. Typhoon days numbered 42, which is a record low, since establishment of the Joint Typhoon Warning Center (JTWC) in 1959. A typhoon day is defined as a day on which a typhoon occurred. Two typhoons on 1 day are counted as 2 typhoon days. Tables 1 and 2 contain the statistics on the storms for past years.

The most striking period of inactivity was the lack of development during the first 6 mo of the year, a period in which, on the average, five tropical storms are charted. Since World War II, only in 1952 has this region experienced a similar late start--through May--of the tropical storm season. Also notable for periods of inactivity were the months of August and September, which produced only 11 typhoon days, as compared to the average of 37.

The monsoon trough did not become well established across the Philippine Sea until October, when three successive typhoons developed in the Yap-Guam area. The lack of a persistent trough during much of the season, especially its eastward extension to the central Caroline and Mariana areas, gave rise to an abnormally low formation frequency east of 135°E.

The percentage of typhoons that reached the severe category was low, as only 3 of the year's 12 (Billie, Nora, and Patsy) achieved the supertyphoon threshold (130 kt or greater). This compares with the mean of six, based on the past 15 yr (1959-73). Nora was the most intense, with sustained winds estimated at 160 kt, and the longest lived of the year, maintaining typhoon strength for 6 days. There were several occurrences of multiple tropical storms (Billie-Clara, Billie-Dot-Ellen, Georgia-Hope-Iris, Nora-Opel-Patsy, Patsy-Ruth).

Several tropical cyclones dealt destruction to the Far East during 1973. The Republic of the Philippines once again bore the brunt of casualties. Typhoons Nora, Ruth, and tropical storm Vera brought a combined death toll of approximately 155 to the island republic. Interestingly, the main Japanese islands did not experience a coastal crossing of a typhoon-strength storm during 1973--a first, according to the records available since 1945.

The statistics for 1973 storms are contained in table 3. The storm tracks (figs. 11-13) and maximum winds are based on poststorm analysis. The dates given include the period when the storm was first identifiable, no matter what stage, until it dissipated or became extratropical. Maximum winds are over-water estimates of sustained wind speeds for a 1-min averaging period.

Table 1.--Frequency of tropical storms (including typhoons) by months and years*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945	0	0	0	1	1	3	5	7	6	1	3	0	26
1946	0	0	1	0	1	3	3	2	3	1	2	0	16
1947	0	0	1	0	1	1	3	3	5	6	6	1	27
1948	1	0	0	0	2	2	2	5	0	4	3	2	22
1949	1	0	0	0	0	1	5	5	6	1	3	3	25
1950	0	0	0	0	1	2	3	3	3	3	3	1	19
1951	0	0	1	2	1	1	1	3	3	4	1	2	17
1952	0	0	0	0	0	3	3	4	5	6	3	4	28
1953	0	1	0	0	1	2	3	6	3	4	3	1	23
1954	0	0	1	0	1	0	1	6	4	3	3	0	19
1955	1	0	1	1	0	1	6	3	3	4	1	1	23
1956	0	0	1	3	0	1	3	5	5	3	3	1	32
1957	3	0	0	1	1	1	3	5	5	4	3	0	31
1958	1	0	0	0	1	3	5	3	3	3	3	1	33
1959	0	1	1	1	0	0	3	6	6	4	3	1	26
1960	0	0	0	1	1	3	3	10	3	4	1	1	27
1961	1	1	1	1	3	3	3	4	6	6	1	1	31
1962	0	1	0	1	2	0	0	7	3	5	3	3	30
1963	0	0	0	1	1	3	4	3	5	3	0	3	33
1964	0	0	0	0	2	2	7	5	7	5	3	1	40
1965	3	2	1	1	2	3	5	6	7	3	3	1	34
1966	0	0	0	1	2	1	5	5	7	3	3	1	32
1967	1	0	2	1	1	1	6	8	7	4	3	1	35
1968	0	0	0	1	1	1	3	8	3	6	4	0	27
1969	1	0	1	1	0	0	3	4	3	3	3	1	19
1970	0	1	0	0	0	2	3	6	4	5	4	0	25
1971	1	0	1	3	4	2	5	4	6	4	2	0	32
1972	1	0	0	0	3	1	7	4	6	4	3	1	30
1973	0	0	0	0	0	1	6	6	2	3	3	1	21
Total	18	7	18	30	53	64	115	147	133	109	77	31	742
Avg.	.86	.34	.86	1.43	2.52	3.05	5.48	7.00	6.33	5.19	3.67	1.48	35.33

*Prior to 1970, the month of occurrence may have been determined by the date the first warning was issued.

Table 2.--Frequency of tropical storms reaching typhoon intensity by months and years*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945	0	0	0	0	0	1	3	5	3	1	1	0	13
1946	0	0	1	0	1	1	3	1	3	1	3	0	13
1947	0	0	0	0	1	1	0	3	4	5	4	1	19
1948	1	0	0	0	2	0	2	3	4	1	3	1	15
1949	1	0	0	0	0	1	3	3	3	1	1	1	14
1950	0	0	0	0	1	1	1	2	1	3	3	1	12
1951	0	0	1	2	1	1	1	2	3	3	1	2	16
1952	0	0	0	0	0	3	1	3	3	4	3	3	19
1953	0	1	0	0	1	2	3	4	3	4	3	1	17
1954	0	0	0	0	1	0	1	4	4	2	3	0	15
1955	1	0	1	1	0	1	3	2	2	2	1	1	15
1956	0	0	1	1	0	0	3	4	5	1	3	1	19
1957	1	0	0	0	1	1	1	2	5	3	2	0	16
1958	1	0	0	0	1	2	4	2	3	3	3	1	20
1959	0	0	0	1	0	0	1	5	3	2	2	2	17
1960	0	0	0	1	1	0	2	2	0	4	1	1	12
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	0	1	2	0	5	7	2	4	3	24
1963	0	0	0	1	1	2	3	2	3	4	3	0	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	2	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	6	2	0	1	22
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	3	4	0	19
1969	1	0	0	1	0	0	2	2	2	3	1	0	13
1970	0	1	0	0	0	1	0	4	2	2	1	0	11
1971	0	0	0	2	1	2	0	3	3	3	1	0	24
1972	1	0	0	0	1	1	5	2	4	4	3	0	22
1973	0	0	0	0	0	0	4	3	2	2	0	0	12
Total	8	2	6	17	24	31	76	100	94	80	53	20	517
Avg.	.38	.07	.21	.59	.83	1.07	2.62	3.45	3.24	2.86	1.83	.69	17.83

*Prior to 1970, the month of occurrence may have been determined by the date the first warning was issued.

The individual typhoons during 1973 are described in the following narratives. Specific times and tables and figures are GMT, but generalized times, such as afternoon of, may be local time. Tropical storm summaries can be found in the appropriate Smooth Log of the Mariners Weather Log.

TYPHOON ANITA

After 6 quiet months, the tropical North Pacific gave birth to its first typhoon of the year. Anita became an organized depression about 350 mi east of Saigon in the South China Sea on July 5. Reaching tropical storm force the following day, Anita began to drift

Table 3.--1973 western North Pacific tropical storms and typhoons

Name	Intensity	Date	Maximum surface wind (kt)+	Minimum observed sea level pressure(mb)	Deaths*	Missing*	Principal areas affected
Wilda	TS	June 28-July 4	60	982	---	---	Philippines, China
Anita	TY	July 5-8	70	980	---	---	North Vietnam
Clara	TS	July 11-14	50	998	---	---	Remained over water
Billie	STY	July 10-19	130	916	---	---	Shantung Peninsula, China
Dot	TY	July 12-20	85	978	1	---	Hong Kong, China
Ellen	TY	July 17-29	105	941	---	---	Japan, as depression
Fran	TS	July 26-30	40	1002	---	---	Remained over water
Georgia	TY	August 7-14	70	976	---	---	Hai-nan, southern China
Hope	TS	August 7-13	45	996	---	---	Remained over water
Iris	TY	August 7-17	85	972	9	3	Ryukyus, Korea
Joan	TS	August 16-22	45	990	---	---	Over water except as depression
Kate	TS	August 21-26	60	983	---	---	Hai-nan, North Vietnam
Louise	TY	Aug. 31-Sept. 7	75	974	---	---	Philippines, Luichow Peninsula
Marge	TY	Sept. 8-15	80	964	---	---	Philippines, Hai-nan, North Vietnam
Nora	STY	Sept. 30-Oct. 10	160	877	22	48	Philippines, Taiwan, China
Opal	TY	Oct. 3-8	75	968	---	---	South Vietnam
Patsy	STY	Oct. 5-14	140	893	---	---	Philippines
Ruth	TY	Oct. 10-19	90	957	27	23	Philippines, Hai-nan
Sarah[x]	TS	Nov. 8-12	55	984	50	---	South Vietnam
Thelma	TS	Nov. 11-18	55	991	---	---	South Vietnam
Vera	TS	Nov. 16-26	50	990	75	58	Philippines, as depression
					177	132	

+ Estimate over water (period--1 min)
* Statistics recorded as available
x Moved into Bay of Bengal on Nov. 13 and became Tropical Cyclone 37-73
TS - Tropical Storm; TY - Typhoon; STY - Supertyphoon

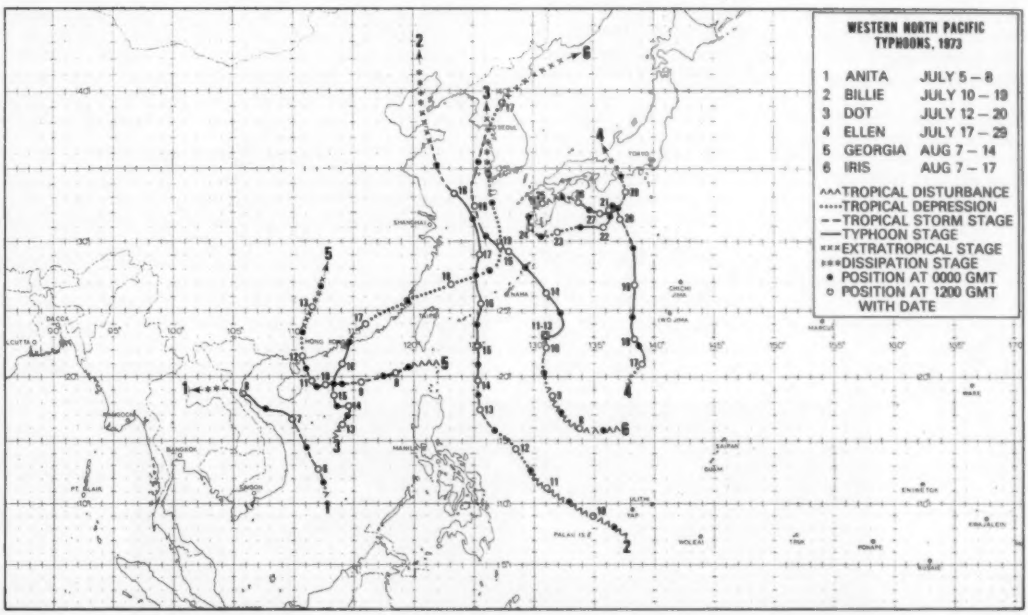
WESTERN NORTH PACIFIC TYPHOONS, 1973
1 ANITA JULY 5 – 8
2 BILLIE JULY 10 – 19
3 DOT JULY 12 – 20
4 ELLEN JULY 17 – 29
5 GEORGIA AUG 7 – 14
6 IRIS AUG 7 – 17
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM STAGE
TYPHOON STAGE
EXTRATROPICAL STAGE
DISSIPATION STAGE
POSITION AT 0000 GMT
POSITION AT 1200 GMT WITH DATE

Figure 11.--Tracks of western North Pacific typhoons, July 5 through August 17, 1973.

north-northwestward in response to a weakness in the midtropospheric subtropical ridge across southern China.

The storm's circulation at this time was marked by stronger winds in its southern semicircle than elsewhere, due to an increased southwest monsoonal

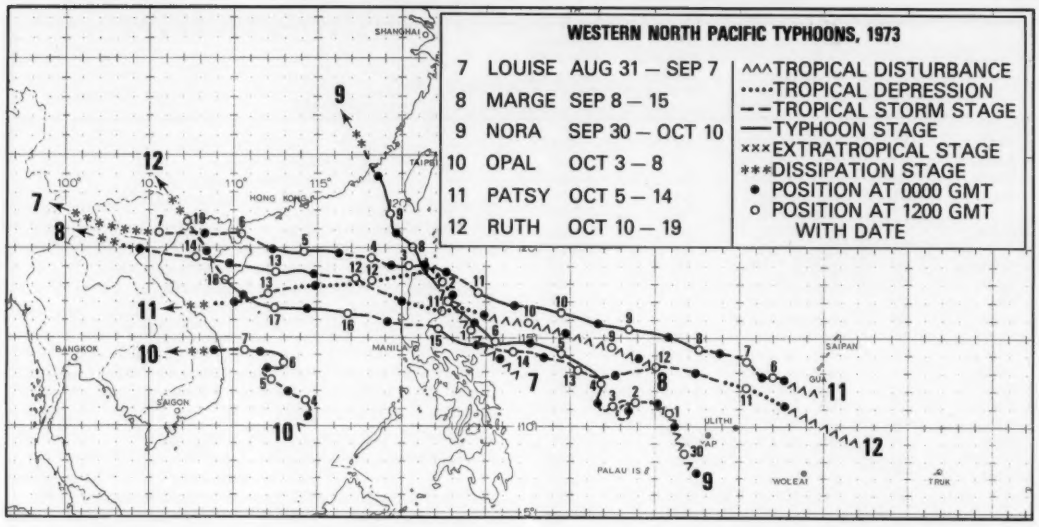

Figure 12.--Tracks of western North Pacific typhoons, August 31 through October 19, 1973.

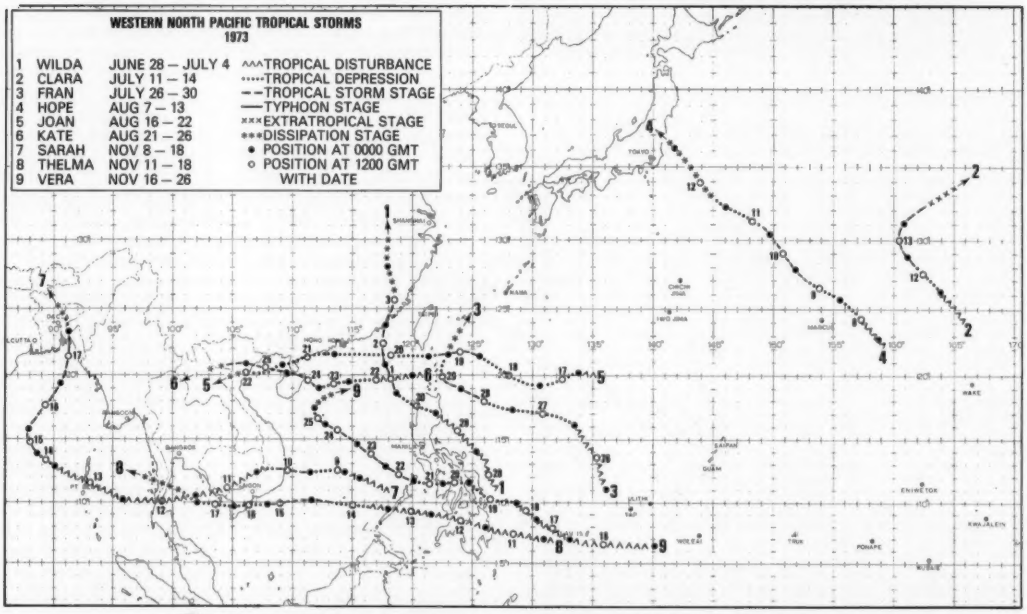
WESTERN NORTH PACIFIC TROPICAL STORMS 1973
1 WILDA JUNE 28 – JULY 4
2 CLARA JULY 11 – 14
3 FRAN JULY 26 – 30
4 HOPE AUG 7 – 13
5 JOAN AUG 16 – 22
6 KATE AUG 21 – 26
7 SARAH NOV 8 – 18
8 THELMA NOV 11 – 18
9 VERA NOV 16 – 26
^^^TROPICAL DISTURBANCE
·····TROPICAL DEPRESSION
– –TROPICAL STORM STAGE
——TYPHOON STAGE
×××EXTRATROPICAL STAGE
***DISSIPATION STAGE
• POSITION AT 0000 GMT
o POSITION AT 1200 GMT WITH DATE

Figure 13. --Tracks of western North Pacific tropical storms, 1973.

flow. Several ships, including the Japanese tankers TOYAMA MARU, RANGOON MARU, and the USNS WASHOE COUNTY, reported winds of 30 kt, 35 kt, and 50 kt, respectively, at 1200 on the 6th--all located within 250 mi of Anita's center in the southwestern quadrant.

By 0845 on the 7th, Anita's central pressure had fallen to 983 mb, and winds around her center had reached typhoon force. Anita began to shift to a more westerly course within 6 hr, as an extension of a subtropical ridge from a 500-mb HIGH in the East China Sea began to build over southern China.

The typhoon, now targeted in on North Vietnam, traversed the Gulf of Tonkin with little intensity change, at a forward speed of 8 to 12 kt for slightly more than a day. The eye finally arrived onshore near Vinh at 1200 on the 8th. Moving inland over the highlands region, Anita weakened rapidly to a low-

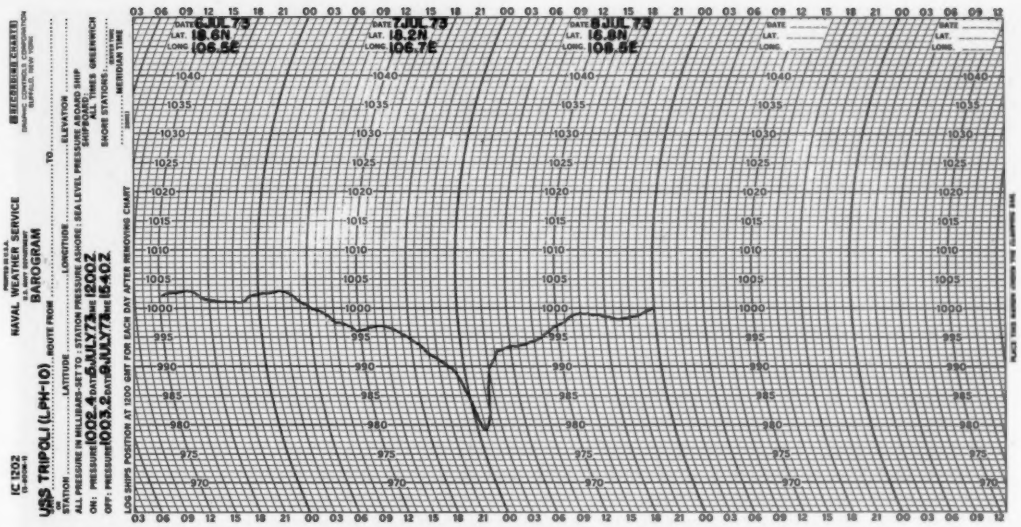

Figure 14.--Reproduction of barograph trace from the USS TRIPOLI during encounter with typhoon Anita.

pressure area and dissipated over Laos by the 9th.

During Anita's trek across the Gulf of Tonkin, two ships reported eye passage. These were the USS OGDEN and USS TRIPOLI, approximately 60 mi east of Dong Hoi, North Vietnam. The USS OGDEN experienced winds greater than 60 kt and recorded a barometer reading of 981 mb at 0000 on the 8th. The barograph aboard the USS TRIPOLI (fig. 14) dipped to 979 mb 1 hr later.

SUPERTYPHOON BILLIE

Billie, the season's first supertyphoon, became a tropical depression in the western Philippine Sea some 250 mi east of Luzon on July 12. Her early history can be traced to the Yap-Palau area on the 10th, as a weak circulation in the monsoon trough.

Billie initially tracked westward, gradually shifting to the northwest in response to a long wave, mid-tropospheric trough over eastern China. Reaching tropical storm force late on the 13th, Billie assumed a northerly course at a speed of 7 kt.

The long wave trough remained stationary, influencing Billie to maintain a meriodonal track at about 8 kt. Her center never deviated more than 30 mi from either side of 125.5°E for 4 days, covering a distance of 720 mi. This steadiness in direction for such an extended period of time sets Billie apart from any other northward-moving typhoon during the period 1945-72.

Rapid deepening occurred once typhoon-strength winds were attained early on the 14th, as Billie's central pressure fell 50 mb in 24 hr. At 0330 on the 15th, aircraft reconnaissance indicated that the central pressure had dropped to 916 mb within a tightly organized eye 8 mi in diameter.

Billie's central pressure rose to 954 mb during the next 18 hr, as she approached the Ryukyus. Commencing an unusual second deepening as she crossed the island chain, Billie's central pressure dropped to 917 mb in the East China Sea at 1154 on the 16th.

Billie passed just east of Miyako Jima (fig. 15), where maximum sustained winds of 65 kt (10 min

Figure 15.--Satellite view of typhoons Billie and Dot on July 17th. Dot is moving near Hong Kong as Billie, with winds of 115 kt, tracks northward in the East China Sea (DMSP VHR data).

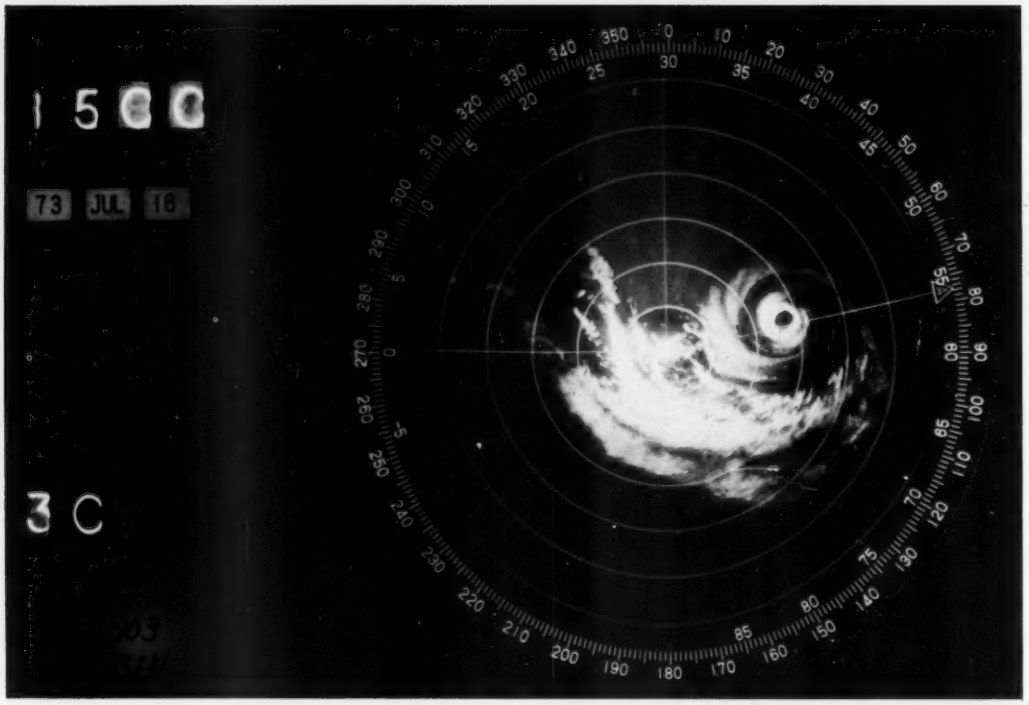

Figure 16.--Typhoon Billie as observed from the Ishigaki Jima radar at 0600 on the 16th, as the typhoon passed through the Ryukyu Islands. Billie's eye is located 80 mi from the station. Courtesy Japan Meteorological Agency.

average) with gusts to 104 kt were recorded at 0700 on the 16th. The lowest pressure reading at the Japanese Meteorological Agency Station was 947.5 mb at 0650.

The island of Okinawa experienced gale-force winds as Billie transited northward through the East China Sea. Naha registered maximum sustained winds of 35 kt, with gusts to 58 kt, at 1700 on the 16th, while White Beach Naval Port Facility recorded 45 kt sustained with gusts to 55 kt at 1900. Land radar showed that Billie's eye passed 105 mi west of Okinawa at 1800 (fig. 16).

On the 18th, Billie shifted to a northwest course 120 mi south-southwest of Cheju-do Island. Satellite imagery indicated drier air off the Asian Mainland was entering Billie's circulation at this time. She weakened significantly during the 18th, dropping to tropical storm status late that day, while tracking into the Yellow Sea.

Approaching the Gulf of Chihli on the 19th, Billie acquired extratropical characteristics and accelerated to a forward speed greater than 20 kt. Billie finally moved inland near Chin-Chow, China, and dissipated on the 20th.

TYPHOON DOT

While Billie gained strength as a tropical storm in the west central Philippine Sea, and tropical storm Clara was in the process of recurvature 700 mi north-northwest of Wake Island, a third circulation appeared in the South China Sea. This circulation intensified to tropical storm force late on July 14, acquiring the name of Dot.

During the first 2 days of her existence, Dot drifted northward and meandered somewhat, about 300 mi south of Hong Kong, as her movement appeared to be retarded due to a slight Fujiwara interaction with typhoon Billie to the east.

The observation of the British ship HYRIA, located 60 mi southeast of Dot's center, recorded 55-kt winds and a pressure of 989.3 mb at 0600 on the 15th, and was indicative of her soon reaching typhoon strength some 12 hr later. Dot then began to increase in forward speed to a rate of 9 kt and attained a peak intensity of 85-kt winds, 80 mi south of Hong Kong, passing just east of the colony at 2300, moving ashore near Mirs Bay.

The Royal Observatory, 12 mi west of the center, recorded maximum sustained winds of 32 kt (10 min average) and gusts to 76 kt. Other meteorological extremes within the colony showed a minimum pressure of 976.9 mb at Cape Collinson and a maximum sustained wind of 57 kt (10 min average) with peak gusts of 86 kt at Wanglan Island. A total of 8.4 in of rain fell at the Royal Observatory during the 16th and 17th, local time (fig. 15).

Damage reports from Hong Kong indicated many low-lying areas in the New Territories were flooded. Landslides killed one person. Two freighters were beached, and six others dragged their anchors.

Dot weakened to a low-pressure area after landfall on the South China coast and entered the East China Sea as a tropical depression near Foochow early on the 18th. Following the wake of Billie, the depression tracked westward, then abruptly shifted northward, dissipating along the western coast of Korea on the 20th.

TYPHOON ELLEN

Initially spotted by satellite, the existence of a circulation some 400 mi south-southwest of Iwo Jima was confirmed by reports from the MEISHUSAN MARU on July 16th. The circulation destined to be Ellen had developed in a trailing surface trough southeast of typhoon Billie. Ellen quickly generated to tropical storm force by the following day. Aircraft reconnaissance at 2210 on the 17th found that a 10-mi circular eye had formed. A minimum pressure of 978 mb and 70-kt winds were observed at 700-mb flight level near the center, indicating Ellen had reached typhoon strength.

Drifting slowly at first, the typhoon began to increase its forward rate of speed by the end of the 18th. This acceleration was in response to a zone of confluence created by midtropospheric troughing in the East China Sea by weakening typhoon Billie and a building high-pressure cell east of Ellen. Ellen tracked northward under this steering flow through the 20th, while achieving her peak intensity at 0420 on the 19th, when reconnaissance aircraft observed a central pressure of 941 mb and maximum winds of 105 kt.

Ellen weakened significantly during the next 24 hr, and dropped to tropical storm status some 180 mi south-southwest of Hachijo Jima, as she moved beneath upper tropospheric northerly flow of 35 to 40 kt, creating a hostile environment for the storm to survive. Ellen deteriorated to depression status early on the 23d, after commencing a meandering course which culminated in a loop over Kyushu and the southwestern Shikoku Islands during the next 3 days, as steering currents remained weak for guidance of the low-level circulation. Reports indicated 3.4 to 10.5 in of rain were recorded in the mountainous terrain of Kyushu, aiding in relieving the drought-stricken Kumamoto Prefecture. By the 27th, as the depression drifted eastward 90 mi south of the Kii Peninsula, satellite imagery indicated that Ellen was rejuvenating. Several Japanese vessels, including the weather ship OJIKA, reported winds of 30 to 35 kt near Ellen's center, at 0000 on the 28th. The intensification was short-lived, however, as Ellen recurved and weakened prior to landfall on the 29th. The circulation finally dissipated near Nagoya, Japan, later that day, with heavy rains up to 4 in recorded in the Ise Bay area.

TYPHOON GEORGIA

The first signs of a disturbance in the Luzon Strait were indicated in satellite and ship report data on August 7. The developing depression entered the South China Sea on a west-southwesterly heading, becoming tropical storm Georgia about 50 mi south of Pratas Island on the 9th. Georgia progressed at a moderate forward speed of 6 to 9 kt as she was guided along by ridging extending from a midtropospheric HIGH centered in the Yellow Sea.

Developing to a minimal typhoon on the 10th, her forward progress slowed some 90 mi east of Hai-nan Island, as the ridge began to recede over eastern China and the HIGH center moved into the Sea of Japan. Georgia performed an abrupt change in track on the 11th, in response to this weakness created in the subtropical ridge over southern China.

Indication that winds had dropped to tropical storm strength was evidenced in satellite data early on the 12th, some 6 hr before Georgia moved ashore on the southern China coast, east of the Luichow Peninsula. The system weakened to a low-pressure area quickly thereafter, as it moved inland.

Georgia was only the fifth tropical storm to reach typhoon intensity in the South China Sea during August since 1945. The most recent was Cora in 1972.

TYPHOON IRIS

August's second typhoon developed from a depression in the Philippine Sea, and was first noted as a circulation 400 mi north of Yap on the 8th. After tracking northward for several days and gaining tropical storm status, Iris slowed and performed an erratic anticyclonic loop some 300 mi southeast of Okinawa during the 11th. The following day, winds of typhoon force were occurring around a broad center, approximately 50 mi in diameter, as Iris began to advance northward again.

By the 14th, the typhoon shifted to a northwesterly heading around the periphery of a midtropospheric HIGH, east of northern Honshu, and started to increase its forward rate of movement from 7 to 12 kt. Passage of Minami Daito Jima occurred about 0700 on the 14th, as the Japanese meteorological station measured a minimum pressure of 974.7 mb. Peak gusts of 63 kt were registered from the southwest some 11 1/2 hr (1830) after passage of the surface center.

Iris' circulation was quite extensive during her trek over the Philippine Sea, covering an area over 700 mi in diameter. The diameter of the typhoon's eye was also enormous, as satellite estimates of its ragged appearance ranged from 50 mi on the 11th to 100 mi on the 13th and 14th (fig. 17).

Iris crossed the northern Ryukyu Islands over the southern tip of Amami-O-Shima. The barograph at the Japanese meteorological station at Naze dipped to a minimum reading of 978 mb, and a wind shift was experienced at 0030 on the 15th. The center was so broad that the barograph trace showed less than 1 mb change for over 10 1/2 hr. The peak gust of 55 kt at 0950 did not occur until over 9 hr after the wind shift. A rainfall total of 10.3 in was recorded during the 3-day period (14th-16th) that the island was affected by Iris. Two fishing vessels were reported lost in the vicinity of the island during her passage. As she entered the East China Sea, satellite pictures revealed her large eye to be filling with clouds and a general weakening appearance was noted during the 15th. As Iris' track began to bend towards the north, around the midtropospheric HIGH centered east of Honshu, she dropped below typhoon strength during the 16th.

Commencing gradual acceleration at a speed of 20 kt with the approach of a short-wave trough in the

Figure 17.--Typhoon Iris, with an unusually large eye, is situated 270 mi southeast of Okinawa on August 13 at 0234. The distal circulation of former tropical storm Hope can be seen just east of the Chiba Peninsula, Japan (DMSP VHR data).

westerlies, Iris' center moved ashore on the western Korean coast near Kaesong, accompanied by winds of minimal tropical storm force, shortly after 0600 on the 17th. Continuing to cross northern Korea, Iris emerged from the eastern coast near Wonsan some 6 hr later. Iris began to transform into an extratropical system as she drew a front moving off Manchuria into her circulation on the 18th. Subsequently, she accelerated to the northeast across the Sea of Japan, crossing Hokkaido late that day.

Meteorological extremes on the western coast of Korea were reported at Kunsun Air Base, which recorded maximum sustained winds of 46 kt, with a peak gust of 64 kt (0646) as the storm center passed 25 mi to the west on the 17th.

Newspaper reports from Korea indicated two persons were killed and hundreds were left homeless on Cheju Island. A barge carrying six persons sank in the sea off Tangsan-gun; all but three were rescued.

TYPHOON LOUISE

Louise's initial stages were detected by satellite in the west central Philippine Sea northeast of Samar Island on August 31. She generated to tropical storm strength just north of Luzon late on September 2. On the 3d, the circulation appeared to be intensifying further, as the British ship SHEAF TYNE, 30 mi to the north of Louise's center, reported 60-kt winds in squalls at 0000.

Emerging into the South China Sea, the storm tracked westward at 9 to 10 kt, under the influence of a developing midtropospheric anticyclone over southern China. Louise reached minimal typhoon force by 0000 on the 5th, about 55 mi south of Pratas, as reconnaissance aircraft reported a central pressure of 986 mb. She remained a relatively small typhoon before landfall on the Luichow Peninsula at midday of the 8th, as 30-kt winds did not appear to extend much beyond 100 mi, as evidenced by ship reports. Wanglan Island in Hong Kong, however, did report 31-kt winds and gusts to 43 kt as Louise passed 150 mi south of the colony on the 5th.

After a brief traverse of the Gulf of Tonkin, Louise, with winds of tropical storm strength, landed near Haiphong, North Vietnam, early on the 7th, weakened to a low-pressure area, and dissipated over northern Laos.

See "Letters to the Editor" on page 256 for an account of an encounter with Louise by the TREDAN.

TYPHOON MARGE

Five days after the demise of Louise, Marge entered the South China Sea on September 12 as a tropical depression. Following her transit of northern Luzon, Marge quickly developed to tropical storm strength 125 mi northwest of Cape Bolinao. As steering currents were essentially unchanged over southern China, Marge was destined to follow the wake of her sister Louise by striking North Vietnam 2 1/2 days later.

Maintaining a forward speed of 11 kt, Marge intensified steadily after entering the open waters of the South China Sea, reaching typhoon force as she passed 200 mi south of Hong Kong early on the 13th (fig. 18). The minimum central pressure that was measured during her lifetime, 964 mb, was reported later in the day at 0900 by reconnaissance aircraft. Marge, like Louise, was characterized by a small circulation limited to 150 mi in diameter. Striking central Hai-nan Island late on the 13th with winds estimated near 80 kt, Marge emerged into the Gulf of Tonkin with tropical storm force some 12 hr later. Eventual landfall was accomplished 60 mi north of Ninh, North Vietnam, late on the 14th. Subsequently, Marge dissipated rapidly inland over the highlands of Laos.

SUPERTYPHOON NORA

Nora, the most intense tropical cyclone of the season, was the first of three typhoons during October to be spawned within the Yap-Guam island area. After an abnormal absence of tropical cyclone activity during the last 2 weeks of September, aircraft reconnaissance of a depression 200 mi north of the Palau Islands revealed the presence of tropical storm Nora. On October 2, Nora's track became erratic for the next 48 hr as she gained strength to typhoon force. Setting out on a northwesterly to westerly course late on the 4th, she began a rapid intensification and crossed the supertyphoon threshold some 24 hr later. On the 6th, Nora's central pressure had reached extreme proportions,

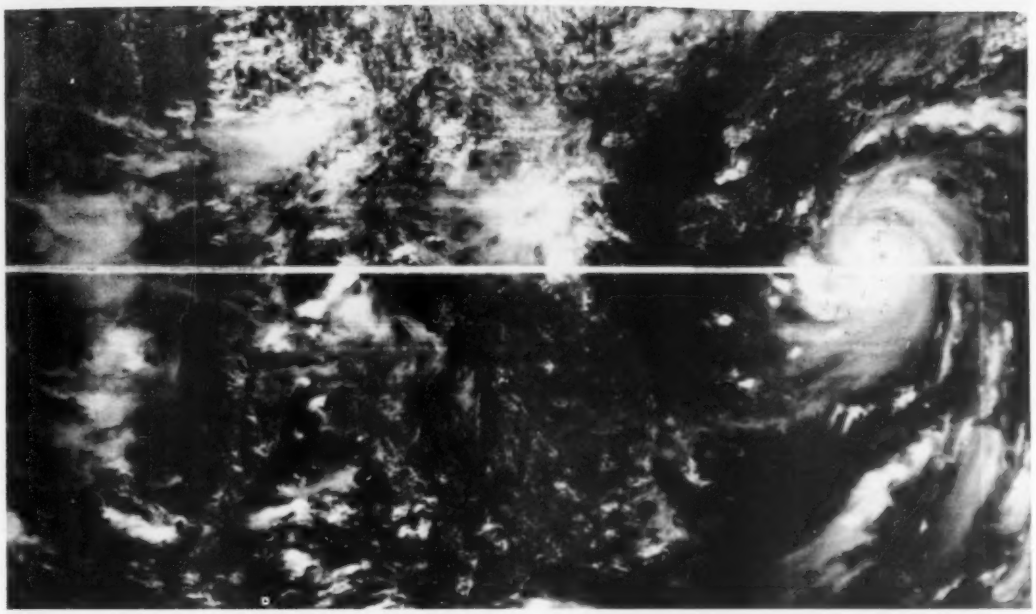

Figure 18.--Typhoon Marge is positioned by satellite 210 mi south of Hong Kong on September 13, at 0513, with winds of 75 kt, as she heads on a westerly course (DMSP VHR data).

as evidenced by the 0020 reconnaissance measurement of 877 mb (fig. 19). This tied the minimum pressure previously on record of 877 mb, as measured by aircraft dropsonde in the eye of typhoon Ida on September 24, 1958. Observers reported at this time a tight circular eye, 8 mi in diameter, enclosed by a panoramic wall cloud with tops rising up to about 30,000 ft. A maximum 700-mb flight level wind of 150 kt, accompanied by severe turbulence, was recorded during penetration of the storm core.

Nora remained at supertyphoon strength for over 24 hr, attaining maximum winds of 160 kt, until she veered to a northwestward track 225 mi east of Manila. This was in response to weakening of the subtropical ridge by a shortwave trough approaching the Yellow Sea. The typhoon tracked offshore of northeastern Luzon on the 7th, with her center crossing the coast briefly east of Aparri late that day, with maximum winds estimated at 95 kt.

Gale-force winds were experienced at several locations along Luzon's western coastline, as Nora emerged into the Balintang Channel of the Luzon Strait. Vigan and Laoag City reported gusts to 56 kt and 50 kt, respectively, on the 8th. Earlier, at 1830 on the 7th, the port area at Manila registered gusts to 68 kt. Nora brought moderate to heavy rains to northern Luzon, as Vigan recorded 10.3 in and Bagio City received 13.3 in during a 24-hr period. The heavy rainfall inflicted widespread damage, as many rivers and streams were flooded and numerous landslides were reported. These conditions were responsible for six deaths and 20 missing. Damage to crops

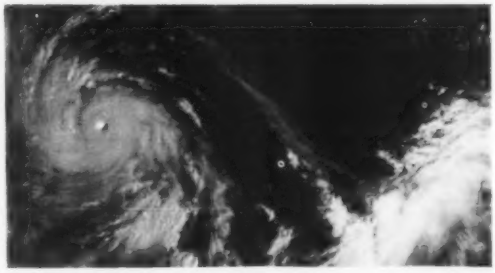

Figure 19.--A satellite view of typhoon Nora at her peak (160 kt) as she traverses the Philippine Sea 400 mi east of Manila on October 5th at 2312. The disturbance to the east of Nora is the formative stage of Patsy, located just west of the Marianas (DMSP VHR data).

and to public and private property was estimated at over $2 million. As a minimal typhoon, Nora continued to move in a northwesterly direction through the Luzon Strait at 6 to 8 kt and tracked 60 mi southwest of Kaohsiung by midday of the 9th.

A peak gust of 68 kt was registered at Tungchi, Pescadores Islands, as Nora's center passed 65 mi south of the station. Following the periphery of a midtropospheric HIGH centered east of the Ryukyu Islands, Nora continued on course, making landfall

Figure 20.--The Taiwan fishing trawler JAI TAI N3 foundered during typhoon Nora in the Taiwan Strait on October 8. U.S. Navy Photo.

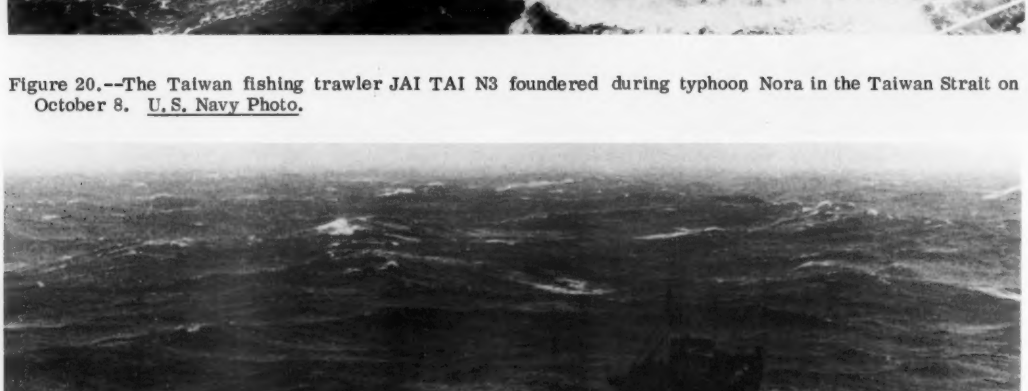

Figure 21.--The rescue by the USS WORDEN of the JAI TAI N3 crew took place over a period of 4 hr, in seas of 30 ft. U.S. Navy Photo.

on the China coast near Quemoy Island early on the 10th. Rapidly weakening, the storm quickly dissipated inland over Fukien Province late that day.

Heavy rains, up to 20.6 in at Sinkong for 20 hr, were recorded in the mountainous region of Taiwan. Many sections of highways were made impassible by numerous landslides, and several bridges and rail lines sections were washed out. Twelve storm-related deaths and 28 missing were reported in Taiwan, while some 300 homes were totally destroyed and 160 badly damaged. Newspapers indicated about 1,000 persons were made homeless.

At sea, Nora played havoc with shipping, as she navigated the Taiwan Strait. The Philippine 3,483-ton freighter ASIAN MARINER sank just south of the Pescadores Islands. All 38 crewmen were rescued. Less fortunate was the 3,724-ton Greek freighter BALTIC KLIF, which capsized and sank about 80 mi southwest of the Pescadores. Three of the crew drowned, with several missing and presumed lost. The missile frigate USS WORDEN rescued the crew of the Taiwanese fishing vessel JAI TAI NR3 (figs. 20 and 21), which was

foundering in the high seas after its forward section split lengthwise. One member of the 8-man crew was lost to the sea.

TYPHOON OPAL

Opal spent her 5-day lifetime in the South China Sea, before finally coming ashore on the South Vietnam coastline on October 8.

Generating to tropical storm strength on the 4th, some 75 mi northwest of Nanshan Island, Opal progressed northwestward for the next 36 hr, attaining typhoon intensity 150 mi east of Tuy Hoa. During the next 24 hr, Opal displayed erratic movement, describing a backwards "S," as she came under the influence of typhoon Nora's circulation 800 mi to the east in the Philippine Sea. As Nora began to veer to a northwesterly heading late on the 6th, Opal commenced a westerly track bearing down on the South Vietnam coastline. Dropping below typhoon status, Opal reached landfall north of Qui Nhon as a weak tropical storm early on the 8th and finally dissipated over the highlands region.

Opal was only the third typhoon to form within the South China Sea in October since 1945. The most recent was Iris in 1970.

SUPERTYPHOON PATSY

With typhoon Nora approaching Luzon and Opal in the South China Sea, the third typhoon of the month was detected by satellite in its formative stages just west of Guam.

The pre-Patsy system dumped 5.3" in of rain on Guam over a 2-day period, causing some local flooding on the island, as she began her trek into the Philippine Sea. Evidence that Patsy was intensifying was provided by satellite on the 7th, revealing her organizing cloud structure. Patsy took a track north of Nora, as a strong midtropospheric suptropical ridge dictated a west-northwesterly course at 7 to 12 kt.

Patsy grew in strength as her central pressure plummeted on the 9th. At her height, the minimum pressure reported by reconnaissance aircraft was 893 mb, at 0020 on the 10th (fig. 22). At this time, winds of 140 kt were packed around Patsy's extremely tight 5-mi diameter eye, marking her as the third supertyphoon of the season. Patsy, however, was an abnormally small storm for its strength, as gale-force winds, at a maximum, were limited to distances of 125 mi in the north and east quadrants. Reconnaissance aircraft penetrating from the west did not encounter 35-kt winds until within 30 mi of the center. Description of the eye by crew members indicated it was not the classic area of relative calm: "The sea state was marked by winds of 130 kt converging to the center. Huge, churning waves approximately 2 mi long, with water sprays that looked like the 'rooster tail' of a high-speed hydroplane, were frequently seen converging to the center."

Late on the 10th, after dropping below supertyphoon strength, Patsy began to deteriorate rapidly, as upper tropospheric outflow from the typhoon became stifled. Within 24 hr, Patsy's winds decreased to tropical storm force, as she approached the northern coast of Luzon. Satellite pictures revealed that the cirrus canopy had detached to the southwest of the center, indicating further weakening. As a depression, she skirted the coastline of Luzon on the 12th, eventually merging with a circulation system in the South China Sea late that day. On a westerly course, she briefly regained storm strength for a short period on the 13th before dissipating off the coast of South Vietnam near Hue the following day.

Figure 22.--Typhoon Patsy is positioned by satellite in the central Philippine Sea, midway between Guam and Manila on October 9 at 2340. Her winds were reaching 140 kt at this time. Weakening typhoon Nora can be seen over the Taiwan Strait (DMSP VHR data).

TYPHOON RUTH

The last typhoon of the year first appeared as a disturbed area of weather on satellite pictures, south of Guam, as Patsy was reaching her peak intensity in the Philippine Sea. Developing from a circulation in the monsoon trough, Ruth traveled on a general westward heading at a quick pace of 15 kt, reaching tropical storm force late on the 11th, 190 mi north of Yap. The storm was guided along the southern periphery of the subtropical ridge on a path somewhat parallel to Patsy's track, but farther south, as the upper-air steering pattern remained essentially unchanged. Ruth continued below typhoon strength for 3 days, until late on the 14th, when she was nearing Catanduanes Island in the Philippines. Aircraft reconnaissance indicated her central pressure had dropped to 982 mb, and winds of 65 kt were observed in the eastern

Figure 23.--Typhoon Ruth is sighted by NOAA-2 VHRR on October 16, west of the Lingayen Gulf, after transit of central Luzon.

quadrant of her circulation.

During the next 20 hr, Ruth's central pressure fell markedly, as she took aim on the central Luzon coastline and slowly accelerated in forward speed. Reconnaissance aircraft observed a minimum reading of 961 mb in her eye a few hours before landfall, near the town of Baler, on the 15th. Transiting the center section of Luzon's rugged mountain terrain in less than 12 hr, Ruth emerged on the west coast, south of Cape Bolinao, just below typhoon strength.

The maximum peak gust recorded at Baler was 95 kt from the north, at 1355, while Casiguran, 50 mi further north on the coast, experienced a gust to 98 kt 3 hr later. Rainfall amounts during 24-hr periods of up to 9.5 in occurred at Baler, while Cabanatuan City, located further inland in the Pampanga River Valley, registered 12.2 in.

The Philippine Red Cross reported 90 percent of the houses and other public buildings in Baler were destroyed and 100 percent of its crops damaged. In addition, rain-swollen rivers washed out bridges and flooded several municipalities in central Luzon. Ruth left in its wake 27 dead and 23 missing, in addition to some 9,000 houses destroyed. Damage estimates exceeded $5 million.

Setting course for the Paracel Island group, Ruth regained typhoon intensity within 12 hr after reaching the South China Sea. An unidentified vessel passed close to the storm's center (fig. 23) 80 mi west of Bolinao Point, at 0600 on the 16th, experiencing easterly winds of 60 kt, with a pressure of 986.6 mb. Ruth continued to be guided on a westerly course by a HIGH that dominated southeastern China. The typhoon continued to grow in intensity as she neared Hai-nan Island and reached her peak of 90-kt winds by midday of the 17th, as reconnaissance aircraft reported that the minimum sea-level pressure near her center had dropped to 957 mb at 0955. Five hours later, a meteorological station on one of the Paracel Islands reported 80 kt, 10-min average, and 970.8 mb, as Ruth's center passed 30 mi to the north at 1500.

Earlier in the day at 0600, the Indian cargo ship VISHVA VIKRAM passed 80 mi southeast of the center and encountered 70-kt winds and 997.1-mb pressure. A Japanese tanker, GINKO MARU, some 120 mi northwest of Ruth's eye, reported 50-kt winds at the same synoptic time.

Ruth turned toward the northwest the following day and crossed western Hai-nan Island, weakening to tropical storm strength late that day. After a brief passage across the Gulf of Tonkin, tropical storm Ruth landed on the North Vietnam coast 50 mi northwest of Haiphong and dissipated over Kwangsi Province in southern China, late on the 19th.

Ruth was the last tropical storm of the season to reach typhoon intensity. This was the earliest on record that a typhoon season has come to a close, at least since World War II.

Hints to the Observer

SEA AND SWELL OBSERVATIONS

Wave observations are important to mariners and to forecasters, who rely on the observations in making analyses and forecasts. The wind, wave, and pressure observations from ships are the only data the forecaster has for estimating when, where, and with what heights those waves will arrive at harbor entrances and beaches. Waves can travel thousands of miles, and the wave energy encountered in midocean may later endanger mariners in a port, on the ocean, or along a coastline.

All mariners are familiar with the practical difficulties in making a "good" wave observation--it takes practice, patience, and determination. Wave observations should be transmitted as the last two code groups in the International Ship Code. Basic instructions for making wave observations can be found in Chapter 9 of Weather Service Observing Handbook No. 1.

An article by C. L. Bretschneider indicated a very close correlation between the significant wave height* and the significant wave period in wave-generating areas. Table 4 is adapted from Bretschneider's findings and is applicable to local seas (wind-generated waves that are still under the influence of local winds). The table does not apply to swells, which are waves that have moved from their generating area.

From the table, it can be seen that higher waves have longer periods. There appears to be a bias on the part of many observers toward reporting the shorter periods associated with smaller choppy waves in a complex sea, rather than the longer periods which are generally associated with the significant (higher) waves. The periods of the larger, well-formed (significant) waves should be reported. The values in the table are only a guide and are not a substitute for accurate observations.

When swells clearly predominate over locally generated seas, the waves have much greater regularity of height and period, as well as longer crests, thus simplifying accurate observations. Swells of a given height normally have a longer period than local waves of the same height.

Wave observations are important. Every effort should be made to give an accurate report, as with the remainder of the observations.

Last, but not least, FORECASTERS NEED AND APPRECIATE YOUR REPORTS. With all the advances in instrumentation and technology, your surface weather observation is the best, most accurate, and, except in isolated instances, the only data available on the world's oceans, approximately 70 percent of the earth.

*Average height of the highest one-third of the waves.

REFERENCE

Bretschneider, Charles L., "Forecasting Relations for Wave Generation," Look Lab Quarterly, Vol. 1, No. 3, July 1970, pp. 31-34.

Table 4.--Typical sea periods for various sea heights within a sea-generating area (adapted from Bretschneider, 1970)

Significant sea height	encoded as:	Significant sea period	encoded as:
up to 6 ft	01 - 03	5 sec or less	02 - 05
7 to 10 ft	04 - 06	6 to 7 sec	06 - 07
11 to 15 ft	07 - 09	7 to 9 sec	07 - 09
16 to 20 ft	10 - 12	9 to 10 sec	09 - 10
21 to 30 ft	13 - 18	10 to 12 sec	10 - 12
31 to 40 ft	19 - 24	12 to 14 sec	12 - 14
41 to 50 ft	25 - 30	14 to 16 sse	14 - 16
51 to 60 ft	31 - 36	16 to 17 sec	16 - 17

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION WORLDWIDE MARINE WEATHER BROADCASTS

Page 2--Opposite "Duluth, Minn." add broadcast time "0638[5]."

Page 3--At bottom of page delete:

Oswego, N.Y.	Wilmette, Ill.
Erie, Pa.	Two Rivers, Wis.
Harbor Beach, Mich.	Plum Island, Wis.
St. Ignace, Mich.	Marquette, Mich.
Charlevoix, Mich.	Portage, Mich.
Ludington, Mich.	

Add to the list: Muskegon, Mich.

Page 6--Halifax, Nova Scotia (CFH): Change frequency "115.3" to read "438[2]." Add frequency "2258 7[3]." Add footnotes: "[2] Off air 1200-1600 second Thursday each month." and "[3] On request."

Page 8--Comfort Cove, Newfoundland (VOO): Change broadcast times to read "0010, 0920, 1720, 1945." Change "161.9 MHz" to "161.65 MHz."

Page 8--St. John's, Newfoundland (VON): Note that the 0000 and 1330 broadcasts on 478 kHz contain the International Ice Patrol Bulletins.

Page 8--St. Lawrence, Newfoundland (VCP): Add forecast area j (Banquereau Bank).

Page 8--Halifax, Nova Scotia (VCS): Add forecast for Halifax Harbor. Change frequency "161.9 MHz" to "161.65 MHz."

Page 8--Sydney, Nova Scotia (VCO): Add broadcast time "0430" to the 1220, 2140 broadcasts on 464 kHz. Replace details of the A_3/F_3 broadcasts with:

VCO	0040, 0955	2598 161.65 MHz	A_3 F_3	Synopsis and forecasts for areas e and f.
VCO	0310, 0800	do.	do.	Synopsis and forecasts for areas a, i, k, r, s, and t.
VCO	1650, 2050	do.	do.	Synopsis and forecasts for areas a, e, f, , j, k, r, s, and t.

Page 8--Canso, Nova Scotia (VAX): Change broadcast times to read "0345, 0820, 1620, 2145."

Page 8--Yarmouth, Nova Scotia (VAU): Replace details of the A_3/F_3 broadcasts with:

VAU	0220, 0910 1710, 2010	2598 161.65 MHz	A_3 F_3	Synopsis and forecasts for areas b, u, v, w, and coastal waters Eastport, Maine, to Merrimack R.

Page 9--St. John, New Brunswick (VAR): Change A_3/F_3 broadcast times to read "0200, 0810, 1540, 2100."

Page 9--Corner Brook, Newfoundland (VOJ): Change broadcast times to read "0150, 1020, 1700, 2155."

Page 9--Grindstone, Magdalen Is., Quebec (VCN): Correct the 440 kHz class of emission to read A_1 and add forecast areas e, g, and x. Change A_3/F_3 broadcast times to read "0240, 0845, 1640, 2020." Change "161.9 MHz" to "161.65 MHz."

Page 9--Fox River, Quebec (VCG): List with the A_3 broadcast details the F_3 frequency 161.9 MHz.

Page 9--Mont Joli, Quebec (VCP): Amend contents of the 0200, 0800, 1400, 2000 broadcasts to read "St. Lawrence Weather Bulletin."

Page 9--Montreal, Quebec (VFN): Add to contents "Water level, Montreal Harbor."

Page 10--Boston, Mass. (NIK): Amend the description of the 0018, 1218 to read, "International Ice Patrol Bulletin containing limit of all known ice, limit of sea ice and iceberg location in area a (March-July approximately). Broadcast at 16 wpm...etc."

Page 16--Norfolk, Va. (NAM): Replace frequency "185 kHz" with "134.9 kHz." In contents column, Part 4, delete all Ocean Weather Stations except Station "H." Insert note that Station "H" is occupied August 1-April 15. Amend footnote 6 to read, "International Ice Patrol Bulletin containing limit of all known ice, limit of sea ice and iceberg locations in area a (March-July approximately)."

Page 19--Lantana (Miami), Fla. (WOE): Delete frequency "17160.8" and related footnote 2.

Page 103--Boston, Mass. (NMF): Delete and insert the following revision:

Station: BOSTON, MASS., USA (NIK/NMF)
Service area: Western North Atlantic Ocean
Frequencies (kHz): 8502, 12750
Transmission speed: 120 scans/minute
Index of cooperation: 576
Schedules: International Ice Patrol Chart[1] (Map A) 1600; wind and sea-height analysis/24-hr wind and sea-height prognosis[2] (Map B) 1830; surface analysis/24-hr surface prognosis (Map B) 1850
Map areas, projection, and scale:
A: Approximately 52°N, 57°W; 52°N, 43°W; 40°N, 43°W; 40°N, 57°W; Mercator; scale 1:3,800,000. (Map

area may be extended eastward depending on ice conditions.)

B: Approximately 22°N, 92°W; 10°N, 65°W; 30°N, 05°W; 72°N, 05°E; Polar stereographic; 1:20,000,000, true at 60°N.

[1] Limit of all known ice, limit of sea ice and iceberg locations, March-July, approximately.

[2] Chart shows areas where wave height is 6 ft or higher.

ACKNOWLEDGEMENT OF RADIO OFFICERS' CORRESPONDENCE

We want to take this occasion to thank the following radio officers for submitting information that will be useful to others:

Edward P. Stevens, AMERICAN VICTORY
W. Jan Leja, LASH ESPANA
Alan L. Van Sickle, AMERICAN ASTRONAUT
C. Miller, AMERICAN ARCHER
John Wrafter, ALMIRANTE
Claude Fernique, KARUKERA
H. K. Tuinman, CHEVRON ARNHEM

Hurricane Alley

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

Tropical cyclone activity in the South Pacific region (east of 100°E) was about normal for March. Three tropical storms and one hurricane plied these waters. One additional storm, Stella, was a borderline case--it was also considered subtropical and not included. No storms formed in April in the South Pacific region; usually, one or two can be expected to close out the season.

The South Indian Ocean had no activity in March, a month when two or three tropical cyclones (tropical storms and hurricanes) can usually be expected. April was average, with one tropical storm. The North Indian Ocean tropical cyclone season was opened in April by a tropical storm that formed in the Arabian Sea. April or May usually marks the beginning of the season. The tracks (figs. 24 and 25) are based on information furnished by the National Environmental Satellite Service, and ship reports are obtained from the National Meteorological Center's Tropical Weather

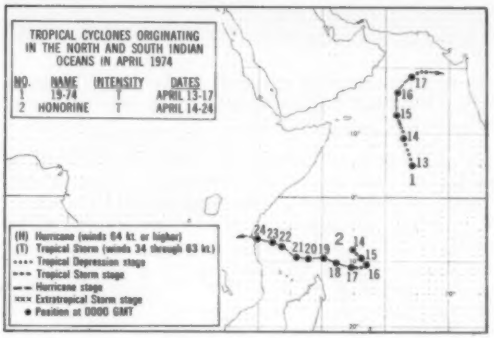
TROPICAL CYCLONES ORIGINATING IN THE NORTH AND SOUTH INDIAN OCEANS IN APRIL 1974
NO. NAME INTENSITY DATES
1 19-74 T APRIL 13-17
2 HONORINE T APRIL 14-24
(H) Hurricane (winds 64 kt. or higher)
(T) Tropical Storm (winds 34 through 63 kt.)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Extratropical Storm stage
Position at 0000 GMT

Figure 25.--Tropical cyclones, North and South Indian Ocean, April 1974.

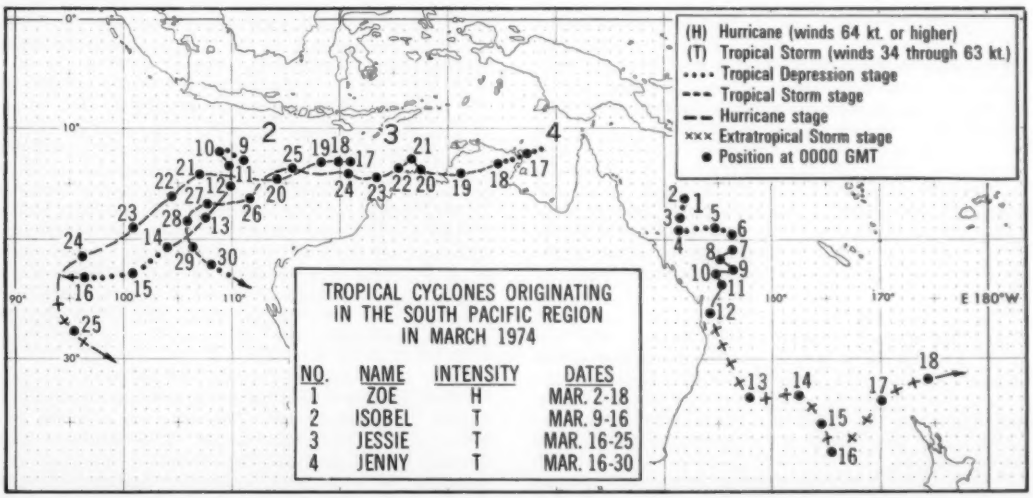
(H) Hurricane (winds 64 kt. or higher)
(T) Tropical Storm (winds 34 through 63 kt.)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Extratropical Storm stage
Position at 0000 GMT
TROPICAL CYCLONES ORIGINATING IN THE SOUTH PACIFIC REGION IN MARCH 1974
NO. NAME INTENSITY DATES
1 ZOE H MAR. 2-18
2 ISOBEL T MAR. 9-16
3 JESSIE T MAR. 16-25
4 JENNY T MAR. 16-30
E 180°W

Figure 24.--Tropical cyclones, South Pacific and South Indian Oceans, March 1974.

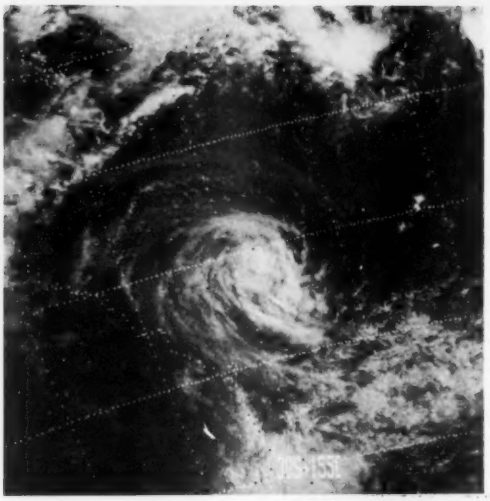

Figure 26.--Zoe, off the west coast of Australia at 2200 on the 9th, is generating maximum winds estimated at about 60 kt.

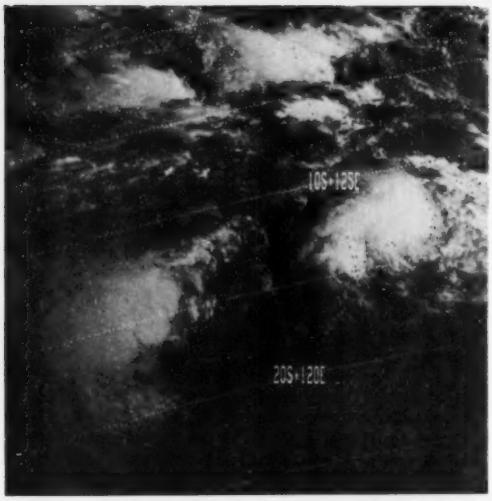

Figure 27.--Jessie (left) and Jenny, at 0014 on the 20th, do their thing off northwestern and northern Australia.

Charts.

SOUTH PACIFIC REGION

Zoe was detected as a tropical depression on the 2d, near Willis Island in the Coral Sea. Meandering southward, she intensified slowly. Zoe reached tropical storm strength on the 6th, as she crossed the 20th parallel. This was confirmed on the 7th by the BUDAPEST, which encountered gale-force winds throughout the day; at 1200, the ship reported 40-kt winds close to the storm's center. By the 8th, Zoe was a hurricane (fig. 26) and probably remained one until the 11th, at which time a report was received from an unidentified ship some 60 mi northwest of Zoe's center. The ship was encountering 60-kt southwesterlies. It was also evident by this time that Zoe, off the coast northeast of Brisbane, was turning extratropical. On the 12th, the extratropical storm headed into the Tasman Sea. Here she gained a second life. On the 15th, the central pressure dropped to 988 mb; by the following day, it was down to 984 mb, and ships were reporting strong winds. Near the center, the NGAKUTA was buffeted by 55-kt winds, while the MAHENO encountered gales some 350 mi to the northwest. As the storm headed east-northeastward on the 17th, ships were still reporting gales. The DONA AMALIA encountered 40-kt winds about 60 mi west of the center.

Meanwhile, on the other side of the continent, Isobel had already formed and dissipated. She was first detected on the 9th, southeast of Christmas Island. Isobel was a tropical storm from about the 10th to the 14th, during which time she traveled southwestward. On the 14th, the AGAMEMNON reported 30-kt winds near the storm's center. Isobel petered out by the 16th.

As Isobel and Zoe were fading on the 16th, Jessie and Jenny were blossoming off northern Australia. Both moved eastward, Jessie through the Timor Sea and Jenny through the Gulf of Carpentaria and across Arnhem Land. Jessie was a tropical storm by the 17th. Near her center, the OTSU MARU reported 30-kt winds at 0000, while the IBERIA encountered 45-kt winds 12 hr later. Jenny took a day longer to reach tropical strength, which she did over land. Neither became a hurricane (fig. 27). On the 21st, Jessie turned southwestward, as Jenny was making it out to sea off Cape Londonderry. Jessie turned extratropical on the 25th, as she recurved southeastward. Jenny was also starting to recurve, but much farther north. On the 26th, the BARON RENFREW ran into 30-kt winds near Jenny's center. She continued to weaken and, by the 30th, was a depression, drifting toward western Australia.

NORTH INDIAN OCEAN

This season's first storm developed in the Arabian Sea. It was sighted as a tropical depression on April 13, near 5°N, 65°E. The depression traveled northward for 2 days before it intensified to tropical storm strength (fig. 28). It remained a tropical storm during the 15th and 16th, as it continued northward. However, on the 17th, it weakened and turned eastward near the 20th parallel. From satellite photographs, it was estimated that the storm reached its peak intensity early on the 15th, with winds of 60 kt close to the center.

SOUTH INDIAN OCEAN

April usually marks the end of the tropical cyclone season in these waters. Usually, one tropical cyclone forms during this month. True to form, one tropical storm developed this April. Honorine was detected as a tropical depression northwest of the Malagasy Republic on the 14th. She moved slowly

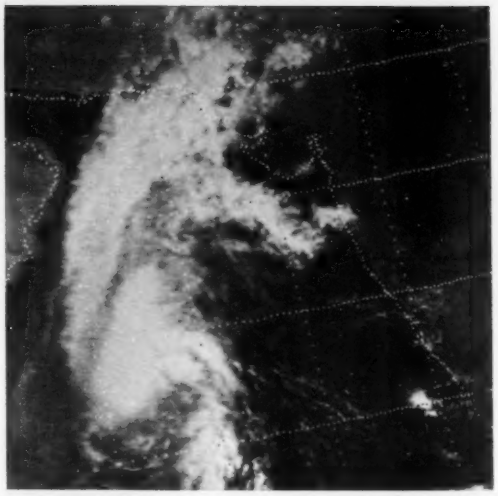

Figure 28. --An Arabian Sea tropical storm, at 0332 on the 15th, generates 60-kt winds close to its center.

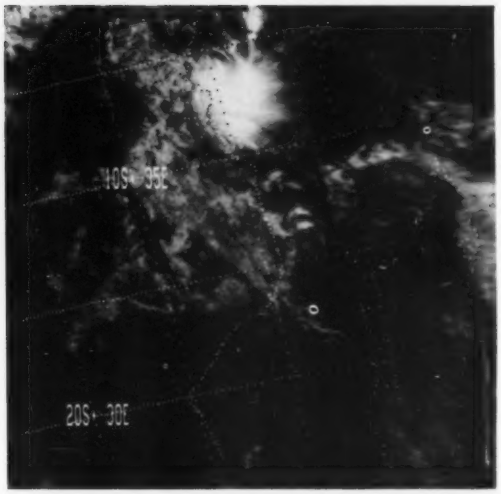

Figure 29. --Honorine is still a tropical storm as she crashes the African coast at 0627 on the 24th.

west-northwestward. By the 17th, Honorine was a tropical storm and was bypassing the Malagasy Republic and heading slowly toward the African mainland. Maximum winds near her center climbed briefly to 50 kt on the 19th. From the 20th to the 24th, the slowly weakening storm moved less than 300 mi to cross the African coast near Dar es Salaam, Tanzania (fig. 29).

On the Editor's Desk

LOCATIONS OF OIL PLATFORMS IN GULF DETERMINED BY SATELLITE OBSERVATION TECHNIQUE

A test program designed to prove the feasibility of accurately determining the location of oil platforms at considerable distances from shore has been completed by the National Oceanic and Atmospheric Administration.

A team from NOAA's National Geodetic Survey established the latitude and longitude of two platforms in the Gulf of Mexico, 40 and 100 mi (64 and 161 km) off the Louisiana coast, by making Doppler observations on a Navy navigation satellite with a geodetic receiver.

Precise determination of the position of offshore oil platforms would enable the oil industry to develop their offshore holdings more fully. At present, boundaries of the oil leases are not sufficiently accurate to allow complete development of petroleum deposits because of the possibility of encroaching on adjacent leases. It has been difficult to determine the exact dimensions of leased areas, and some boundaries are off by a significant amount.

The satellite-Doppler effect system could also delineate areas of ecological concern more accurately, thus affording them greater protection. The system can extend the limits of land-based geodetic controls into marine areas, benefiting all forms of marine development, including fishing, seabed mining, and nautical charting.

In the test survey, the geodetic receiver (Geoceiver), which weighs less than 100 lb, received signals from the satellites of the Navy Navigation Satellite System and measured the Doppler shift and precise time of the satellite signals with signals generated by the Geoceiver. With this information and precise orbital data supplied by the Naval Weapons Laboratory at Dahlgren, Va., the National Geodetic Survey was able to determine the platforms' geographical positions.

The method by which positions on earth may be determined by tracking orbital satellites employs a principle first postulated in 1843 by the Austrian physicist Johann Christian Doppler. Under the Doppler effect, as it has since been known, as a source of wave motion approaches or moves away from an observer, the frequency of the waves received by the observer increases or decreases. This phenomenon is known to everyone who has heard a train whistle, with the pitch changing as the train approaches and then passes. The same phenomenon occurs with the radio waves emitted by an orbiting satellite. The Navy Navigation Satellite System consists of six satellites in polar orbits of 600 to 750 mi (965 to 1207 km) above the earth.

It is difficult to determine the latitude and longitude of platforms which are out of sight of shore through normal land surveying methods. The NOAA geodetic survey teams use portable towers in land measurements to overcome the loss of sight occasioned by the

earth's curvature. While this system of geodetic measurements can be used at sea from some existing platforms, it is costly and time consuming and cannot be used in areas where platforms are widely separated. With offshore oil development pushing farther and farther to sea, another method of measurement had to be devised.

It is anticipated that when the team's data have been processed, the data will show that the position of the oil platforms will have been determined to within an accuracy of plus or minus 6 ft, well within the range of that accomplished on land with the same method. The greater the distance, the greater the accuracy. Currently, the accuracy is estimated at 1 m (about 3 ft) for a 1-million-square-mile area.

The test survey was requested by a group representing major oil interests in the Gulf, where hundreds of oil platforms dot the water for a distance of 150 mi (241 km) from shore.

FOG, FIRE, FOAM, FERRIES, OIL, BARGES, AND A RIVER

I wish to thank the Octagon, an Eighth Coast Guard District publication, from which this item concerning the lower Mississippi River was taken. This same period is covered in the January 1974 North Atlantic Rough Log, on page 132 of Volume 18, Number 2, Mariners Weather Log.

Coast Guardsmen have battled Old Man River for years, but probably never as hard and in so many different ways than the last couple of months. To the man, it is agreed that the river is not only a dirty old man, but a difficult old man to defeat.

Since the first of the year, the river has made the Coast Guard just plain tired; wishful, too--wishing that river ended somewhere in Missouri. But such is not the case.

The biggest headache of all involved two USCG helicopters, four cutters, several civilian boats and aircraft, over 200 men, and a lot of hard work.

On Friday, January 18, at 1900, the American tanker KEYTRADER and the Norwegian freighter BAUNE collided in an explosion of fire and smoke on the Mississippi. Burning gasoline and jet fuel gushed from a gaping hole in the bow of the KEYTRADER, swirled around the BAUNE, and engulfed her in flames. Burning fuel streamed down the river. Crewmembers of both ships began jumping into the river to escape the ravaging flames. Some became helpless victims of the intense heat.

The collision occurred about 16 mi above the mouth of the fog-shrouded river, not far from the USCG Light Attendant Station Venice. As can easily be guessed, Venice became the rendezvous point for the units involved. Venice's 53 ft was the first rescue unit on the scene (fig. 30). Civilian boats and aircraft worked with USCG helicopters in searching downriver for other survivors.

Due to the quick action and cooperation of all the units involved in the rescue operation, only 5 people are known dead, 11 are missing, and 65 were safely

Figure 30.--CGC DEPENDABLE and 53' battle the flames from the tanker KEYTRADER. U.S. Coast Guard Photo.

Figure 31.--Water is poured onto KEYTRADER's deck. U.S. Coast Guard Photo.

rescued, with only 1 of those spending any length of time in the hospital.

The bauxite-laden BAUNE burned itself out in about 2 hr. The KEYTRADER, loaded with 133,000 barrels of gasoline and jet fuel, blazed furiously (fig. 31). The intense heat kept everyone at a good distance, but the 53 ft was able to extinguish the burning fuel floating downriver.

Late that night, the PT SAL and PT SPENCER were able to fight the tanker's fire with foam, but were

Figure 32.--The PT SAL and PT SPENCER stand by the BAUNE, while crewman investigates the damage below deck. U.S. Coast Guard Photo.

Figure 33.--The remnant of the tragedy, a burned lifeboat rests at the BAUNE's stern. U.S. Coast Guard Photo.

forced back until more water power could arrive (fig. 32). It arrived in the form of the USCGC DEPENDABLE, along with 300 cans of foam. The fog, which was bad when the fire started, was so thick that only the loom of the flames could be seen above the fog layer. The fog, coupled with an unfavorable wind, forced them to wait until daybreak.

Saturday morning, the 19th, the DEPENDABLE crew began pouring hundreds of gallons of foam and water onto the blazing ship. They were aided by the ACUSHNET, and, by early afternoon, three firefighting teams and six hoses were aboard the KEYTRADER to fight the fire face to face. At the same time, a firefighting party from the PT SAL worked to contain the smaller fires aboard the BAUNE.

With the increased firefighting capabilities of the ACUSHNET, the fire was rapidly dying. The KEYTRADER's fire flickered, but gas fumes ignited in an explosion, reflashing the fires in two of the forward tanks.

The aft section of the BAUNE had started burning again, and the SAL and SPENCER concentrated their efforts in that area. The DEPENDABLE used up her supply of foam, and all firefighting units were soon withdrawn until more foam could be delivered on Sunday, the 20th.

Several hundred cans of foam arrived on Sunday. The ACUSHNET and DEPENDABLE again were pouring the foam onto the blazing ship. By 2200, the flames were reduced to gas pockets below decks, but water and foam coverage was continued all night.

By sunrise Monday morning, the 21st, the 3-day ordeal had reached an end. All that remained were routine investigations of both ships to recover bodies, check for valuables, and determine the cause and effect of the accident (fig. 33). Rescue units searched for days afterward for survivors. Firefighting units stood by for a few days to keep a close reflash watch and to control river traffic.

The same day the collision occurred, a Shell Oil pipeline 10 mi upriver from New Orleans broke and spilled thousands of barrels of oil into the Mississippi.

Several Captain of the Port (COTP) personnel were involved in monitoring cleanup operations. Over 10,000 barrels of oil have been recovered since the massive oil spill occurred.

Three evenings before that, on the 16th, 40 barges broke loose from their moorings and drifted down the Mississippi. The barges were rounded up quickly, and no damage was suffered. But the incident was only an appetizer.

The very next morning, 139 barges broke loose. About 100 barges broke away in a clump and floated downriver, collecting more barges as they went. Tugs responded quickly, and all the barges were recovered in a few hours, despite heavy fog. But not before the barges had caused extensive damage to levees and wharves on their early morning ramble.

On February 4, the tug F. R. BIGELOW collided with the Destrahan/Luling ferry a few miles above New Orleans. Seven passengers were injured, and several vehicles were damaged, one falling overboard. Two USCG helicopters, a 40-ft, and an 82-ft boat searched downriver afterward for any ferry passengers who might have fallen overboard unnoticed.

As a result, emergency barge regulations were enacted February 12. They controled methods of mooring and ensured quick retrieving of barges should they break loose. COTP and personnel from the 9th District are patroling the river daily to enforce the regulations.

These are only a few of the more important incidents of the past couple of months. Every unit and almost every person worked long hours. It has been a headache for us all, but everyone responded unselfishly to the incredible string of problems. The port of New Orleans may never see such a string of near-disasters ever again. We hope not!

Old Man River again did his dirty deeds, and, although he is a most worthy opponent for anyone, we feel that our people once again met his challenge.

IMPROVED ENVIRONMENTAL OCEAN BUOYS BEING STATIONED OFF U. S. COASTS TO KEEP WATCH ON WEATHER

Three improved environmental ocean buoys will be stationed off the coasts of the United States, bringing to six the large, experimental data-reporting buoys that will be keeping watch on the weather by the end of the year.

One of these weather "sentinels" will be stationed this spring about 300 mi west of Astoria, Oreg. It will be the second in a series of buoys designed to provide data for improved weather forecasts for the tankers which will travel from Valdez, Alaska, to West Coast refineries. The first has been operating 170 mi southeast of Kodiak, Alaska, since October 1972.

Five large deep-ocean buoys have been regularly reporting meteorological and oceanographic data at locations ranging from the often stormy mid-Atlantic coast to the balmy, hurricane-prone waters of the Gulf of Mexico to the harsh, subarctic winter seas in the Gulf of Alaska. Two of these will be replaced by more advanced buoys (EB-14 and EB-15) now being completed and tested by the NOAA Data Buoy Office, at the NASA Mississippi Test Facility near Bay St. Louis.

In addition to the Gulf of Alaska buoy (EB-03), two buoys have been anchored off the East Coast and two in the Gulf of Mexico. The EB-01, stationed about 125 mi east of Norfolk, Va., since February 1970, established a record for being continuously stationed in deep ocean at one location before it went off the air in March 1974. It will be replaced by the EB-10, which has been operating 180 mi southeast of New Orleans since June 1972, after it has been refurbished with the latest modifications to the electronic data-gathering equipment. The new EB-14 will take its place in the Gulf. The second Atlantic buoy, the EB-13, was anchored last December 300 mi east of Charleston, S. C. The remaining buoy, EB-12, has been operating in the Gulf of Mexico since June 1973, about 200 mi east of Brownsville, Tex.

The buoy being stationed off the Pacific Northwest (EB-02) has a different configuration from the 40-ft, 100-ton discus buoys. This 29-ft, 30-ton buoy has a boat-shaped hull. In other respects, however, it is similar to its larger counterparts. It is also built to withstand hurricane winds, high waves, and fast currents, remain on station unattended for long periods of time, and transmit comparable data to shore.

Although experimental, the buoys have been providing data at regular intervals and upon request during threatening weather. They are part of a long-range NOAA data buoy program to acquire essential environmental data using automatic telemetering buoys in areas where it has been difficult to acquire meteorological and oceanographic information with any degree of regularity. These areas are located in the oceans, coastal waters, the Great Lakes, bays, and estuaries.

The buoys off the coasts are designed to provide the data necessary to help furnish better warnings of hazardous seas and winds affecting heavily populated coastal communities and the important tanker routes. The buoy data will also aid in preparing forecasts and warnings for agriculture, shipping, aviation, fishing, construction, military operations, offshore petroleum and mining operations, recreation, and pollution control.

NOAA SCIENTISTS DETECT UNDERWATER WAVES FROM SPACECRAFT DATA

Large underwater oscillations called "internal waves"--usually invisible at the surface--have been

Figure 34.--ERTS-1 satellite picks up internal waves off the New York Bight. Waves appear in groups, parallel to the outer edge of the Continental Shelf.

detected using images from sensors aboard an unmanned spacecraft. NOAA scientists of the Atlantic Oceanographic and Meteorological Laboratories discovered the waves while analyzing images from a multispectral scanner aboard NASA's first Earth Resources Technology Satellite (ERTS-1).

Scientists speculate that internal wave formation by lunar and solar tides, their subsequent breaking, and dissipation of energy are important processes in the gradual lengthening of the day over millions of years. Previously, friction due to tides moving over the rough ocean bottom was felt to be the cause of this slowing down of the Earth's spin. Since the decrease in the Earth's rotation rate requires the constant dissipation of about three million megawatts of power, recent oceanic measurements have cast doubt on the effectiveness of the ocean bottom to accomplish this. Now, internal wave activity has become the candidate. Internal waves are also of interest to scientists because they affect the propagation of sound in the ocean and contribute to the mixing processes in its upper layers.

The waves are very slow, very long, progressive oscillations of stratified layers of water that exist under the surface of oceans and lakes. One complete oscillation typically takes 10 to 30 min, has a wave speed of about 2/3 mi per hr; wave activity typically is most pronounced at 60 to 600 ft below the surface.

Internal waves are probably most familiar to the nonoceanographer through devices sold in novelty stores in which a clear plastic box filled with two liquids of different colors and densities is rocked slowly back and forth. The large waves on the border between the liquids travel majestically along the box and crash into the ends to form breakers. The same kinds of waves can be generated in the ocean wherever changes in water temperature or salinity lead to changes in density of sufficient magnitude.

While the up-and-down motion of the underwater layers may amount to hundreds of feet, very little vertical movement occurs at the surface. Instead, large horizontal motions there affect the very small, wind-caused surface wavelets, changing the way sunlight is reflected and scattered from the parts of the surface overlying the internal waves. This periodic change in reflected sunlight, which travels with and above the underwater wave, appears to be what the oceanographers have detected on the satellite images.

The internal waves were first spotted on satellite images made over the Atlantic Ocean off New York, in the vicinity of the Hudson Canyon--the ancient drowned riverbed on the Continental Shelf, through which the Hudson River flowed during the last glacial period, when the sea level was lower.

The waves appeared as several packets, or groups, each composed of a half dozen or so striations. Each wave was oriented about parallel to the outer edge of the Continental Shelf, spaced approximately 1/4 to 1/2 mi apart. The separation between packets of waves was usually about 6 to 8 mi(fig. 34).

According to the NOAA oceanographers, the packets were observed to progress farther up the Hudson Canyon, because of the deeper water there, than they did over the shallower water on the adjacent shelf. They disappeared where the water depth was about 180 ft.

During the fall and winter of 1972-73, repeated coverage by the satellite showed no further evidence of the waves, most likely because the strong mixing of near-surface Continental Shelf waters by higher winds destroyed the stratification needed to support them. But by May of last year, the waves had reappeared in similar patterns at the headlands of the Hudson Canyon and were observed in fully developed form in July. Similar waves have been identified off New Jersey, Maryland, and southern Africa.

The internal waves are also attributed to tidal action at the deepwater side of the Continental Shelf. Every 12 1/2 hr, as the incoming tidal current encounters the sharp change in depth at the edge of the shelf, the right conditions for launching an internal wave packet are set up for a few hours. Set in motion, this packet, which is concentrated at a depth just below the upper mixed layer of the ocean, travels through the waters over the shelf until reaching the sloping bottom, where it breaks much as a surface wave breaks on the beach.

The several packets seen in some of the ERTS-1 images are probably due to the repetition of this process during several tidal cycles preceding the overpass of the satellite. Because the waves travel so slowly, the packets had not yet had time to break in shallow water before being caught by the satellite's remote-sensors. The spacing observed between

packets is about what is expected for generation every 12 1/2 hr.

COMMERCE DEPARTMENT FLEET LAUNCHES 1974 OCEAN STUDIES

Approximately 1,000 scientists, technicians, officers, and seamen will man 21 Commerce Department ships, plus numerous smaller craft, in a new season of investigations of the oceans and waters that lap the shores of the United States and foreign lands.

Their activities will take them up and down the coasts of the United States to the Caribbean and the Gulf of Mexico, across the Atlantic to Africa, off both coasts of Latin America, into the vast reaches of the Pacific, the Gulf of Alaska, and elsewhere.

They will probe the oceans, including the land beneath and the air above, the coastal waters and estuaries of the United States, the submerged Continental Shelves, the wrecks that dot America's shores, the treacherous currents that endanger seamen and their craft, and the water's abundant aquatic life.

Some work will be glamorous; much of it will be routine, but essential. The mysterious internal waves, which undulate below the surface of the sea, will be probed, as will the mountains, ranges, canyons, and massive fractures in the earth at the bottom of the sea. And scientists will seek additional evidence of the movement of the continents and sea floor spreading. Others will conduct investigations necessary for managing fishery resources. .

While the larger seagoing vessels are carrying on deep ocean activities, the smaller ships of the Commerce fleet will be conducting marine charting surveys, measuring the currents along the coasts and in bays, estuaries, and harbors, and scouring coastal sea lanes for submerged wrecks, pilings, abandoned equipment, coral and rock formations, and other dangers to sea commerce and recreational boating.

Still other vessels will be studying fishery resources, conducting investigations, such as tracking fish migrations and gathering data for predicting areas of occurrence and levels of abundance, studying environmental parameters that affect survival and fluctuations in population, and assessing and evaluating the potential for use of the various fishery resources. Various experiments will be conducted to advance man's knowledge of the ocean's living resources and to develop or perfect assessment equipment and techniques, such as remote underwater observation equipment and diving with or without submersibles.

This year, as during the past few years, NOAA scientists are continuing their research on the interrelated theories of continental drift and sea floor spreading. According to the continental drift theory, the Earth at one time had one or two large land masses which began to split some 200 million years ago. The theory postulates that, as the sea floor spreads, the continents are drifting at about 1 in or so a year. The drifting resulted in the separation of the supercontinents. According to a related theory, the Earth's crust is made up of gigantic, grinding, constantly moving plates or segments.

The studies will seek to extend man's understanding of the ocean and the atmosphere above; to evaluate the living marine resources of waters off the United States and South America; to assess the environmental impact of submerged coastal areas, such as the New York Bight; and to study the behavior of cloud clusters and their role in the larger circulation of the atmosphere. Some studies will involve other U.S. agencies and educational institutions and foreign countries. Various studies are tied in with efforts to obtain data which will help solve the problem of ocean pollution.

A study of the tropical atmosphere and oceans and their effect on the earth's weather will be carried out by the Seattle-based OCEANOGRAPHER and the Miami-based RESEARCHER off the northwest coast of Africa, in conjunction with ships and aircraft of 10 nations.

On the Great Lakes, the SHENEHON will set current meters on Saginaw Bay, after which she will perform research work on the St. Clair and Detroit Rivers and lower Lake Huron, while the LAIDLY, using a newly installed hydroplot system, will make hydrographic surveys on Lake Erie. The JOHNSON will conduct a water quality survey of Saginaw Bay early in the season and will then be shifted to chart revisory surveys on Lake Michigan. The VIRGINIA KEY, operating out of Miami, will conduct near-shore and coastal oceanographic studies.

Much of the work that will be done by NOAA ships in 1974 will be essential to safe navigation. Marine charting surveys will be carried out by the RAINIER, FAIRWEATHER, DAVIDSON, MT. MITCHELL, WHITING, and PEIRCE in the waters of the Carolinas, Georgia, Florida, California, Washington, Alaska, and other areas. McARTHUR will conduct tide and current surveys in Washington and Alaska waters.

Essential also to safe navigation are the wire drag surveys for underwater hazards conducted in the Gulf of Mexico by the RUDE and HECK. Circulatory studies will be performed by the FERREL in the New York Bight, the 15,000-sq-mi area of ocean waters and Continental Shelf that extends from Montauk Point, Long Island, to Cape May, N. J.

MAJOR INTERNATIONAL WEATHER STUDY DESIGNED TO IMPROVE GLOBAL FORECASTS

Weather and oceans over one-third of the Earth's Tropics will be closely examined this summer in the largest and most complex international scientific experiment ever undertaken.

Called GATE--for Global Atmospheric Research Program-Atlantic Tropical Experiment--the project is designed to gather the information needed to understand the behavior of the tropical atmosphere and its effects on global weather. The Tropics are a key but inadequately understood element of the restless planetary circulation of the Earth's atmosphere and oceans. An understanding of the workings of the entire global system is a fundamental prerequisite to reliable weather predictions beyond a few days in the future.

After more than 4 yr of intensive planning, the GATE field investigation will be carried out from June 15 to September 23 in a 20-million-sq-mi area of tropical land and sea extending from the eastern Pacific Ocean--across Latin America, the Atlantic Ocean, and Africa--to the western Indian Ocean. Instruments on 38 ships, more than 60 buoys, 13 aircraft, 6 types of satellites, and at nearly 1,000 land stations will observe and record weather and ocean phenomena from the top of the atmosphere to about 5,000 ft below the sea surface.

Sponsored by the World Meteorological Organization--a specialized agency of the United Nations--and

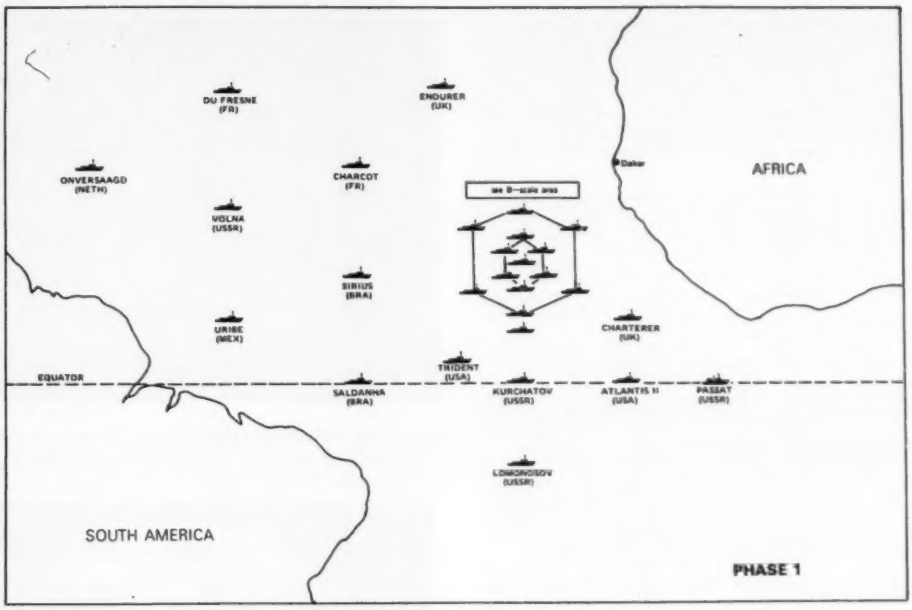

Figure 35.--Array of ships during the first experimental period, June 26 through July 16.

the International Council of Scientific Unions, the 101-day study directly involves some 4,000 scientists, ship and aircraft crew members, and technicians from 66 nations. Field operations will be directed by an international control center established at Dakar through the cooperation of the Government of Senegal.

Scientific director for the experiment is Joachim P. Kuettner, formerly of the National Oceanic and Atmospheric Administration (NOAA) and now Director of the GATE International Scientific and Management Group.

NOAA is coordinating and directing U.S. participation in the project through its U.S. GATE Project Office. Federal agencies contributing to GATE include the Departments of Commerce, Defense, State, and Transportation, the National Aeronautics and Space Administration, and the National Science Foundation.

The primary purpose of the Atlantic Tropical Experiment is to collect the massive quantities of simultaneous observations required to enable scientists to understand tropical weather phenomena, describe them in mathematical terms, and develop improved models for computer weather forecasting.

The Tropics receive half of the sunshine that strikes the Earth and fuels the atmosphere's circulation. Much of this solar heat is first stored in the tropical oceans and then is transferred from sea to air, carried upward in tropical cloud systems, and transported from the Tropics by high-level winds. Although these processes ultimately affect atmospheric circulation and weather all over the Earth, they are inadequately understood.

Especially in the Tropics, weather processes covering a broad spectrum of sizes cooperate to produce effects of global importance. Thus, the Atlantic Tropical Experiment requires an observing system

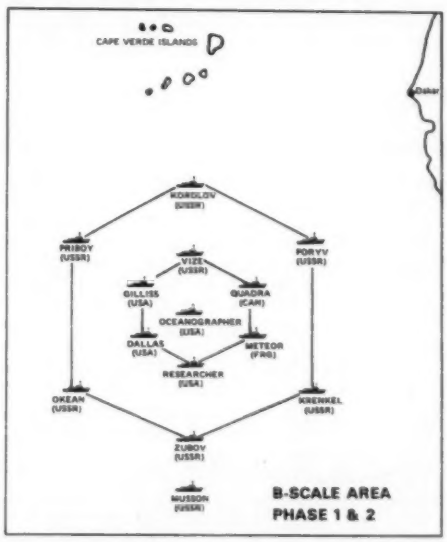

Figure 36.--Intensive ship array in the eastern Atlantic.

capable of studying the full range of phenomena from small groups of cumulus clouds to huge traveling disturbances thousands of miles across.

Of the 38 participating ships from 10 nations, about half will be stationed at points 300 to 600 mi apart across the Atlantic, observing large-scale weather and ocean systems. Others will be concentrated within an area of about 200,000 sq mi in the eastern Atlantic near the African coast (figs. 35 and 36), for a study

of the internal structure of organized systems of tropical cumulus clouds called "cloud clusters." Roving and stationary oceanographic vessels will examine processes in the uppermost layer of the ocean affected by local atmospheric conditions, and study the broad ocean current system near the Equator, which has been called the backbone of the ocean circulation.

Flying at altitudes from 300 to more than 30,000 ft, 13 instrumented aircraft from five nations will gather atmospheric and ocean measurements, principally in the area of the concentrated ship array.

Spacecraft will scan the entire experimental area night and day, furnishing information on clouds and winds, temperature and moisture in the atmosphere, and sea-surface temperatures. The Soviet Union's Meteor satellites and the United States' new SMS-A (Synchronous Meteorological Satellite), ATS-3 (Applications Technology Satellite), Nimbus-5, Defense Meteorological Satellites, and NOAA-2 and NOAA-3 will provide data for the project.

Nations contributing ships or aircraft for the GATE project include Brazil, Canada, France, Federal Republic of Germany, German Democratic Republic, Mexico, Netherlands, United Kingdom, Union of Soviet Socialist Republics, and the United States.

U. S. ships scheduled to take part are the NOAA ships OCEANOGRAPHER and RESEARCHER, the Coast Guard Cutter DALLAS, NASA's VANGUARD, the University of Miami research vessels JAMES M. GILLISS and COLUMBUS ISELIN, Woods Hole Oceanographic Institution's ATLANTIS II, University of Rhode Island's TRIDENT, and Texas A & M University's research vessel GYRE.

The Global Atmospheric Research Program and the World Weather Watch are the major components of the World Weather Program, an international effort coordinated by the World Meteorological Organization.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) LAUNCHED

SMS-1 was launched May 17, 1974, from Cape Kennedy, Fla. The cylindrical, 627-kg (1,379 lb) spacecraft (fig. 37) is stationed over the Equator near 45°W, at the synchronous altitude of 36,357 km (22,591 mi).

The satellite will transmit data to produce day and night pictures (fig. 38) of the Western Hemisphere every 30 min; transmit and relay weather data and pictures to hundreds of small receiving stations; receive and transmit environmental information from manned and unmanned data collection platforms; and monitor solar flare activity.

The Visible Infrared Spin-Scan Radiometer (VISSR) contains eight identical visible channels that operate in the 0.55- to 0.70-micron band and will produce 0.9-km (1/2-mi) resolution images of visible radiation emitted from the cloud tops during the daytime. It also contains a single infrared (IR) (thermal) channel that operates in the 10.5- to 12.6-micron band to make 9.0-km (5-mi) resolution images of IR radiation emitted from the land, sea, and cloud tops during both day and night. These electronically devised images will be received at the NOAA Command and Data Acquisition Station, Wallops, Island, Va., and retransmitted to the National Environmental Satellite Service at Suitland, Md.

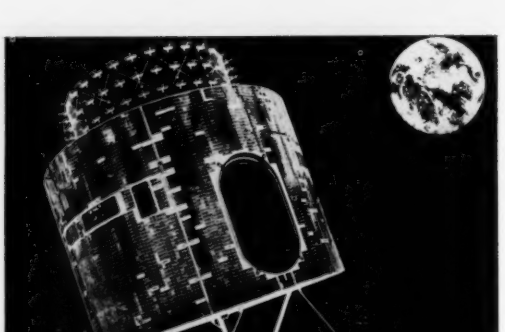

Figure 37.--A composite photograph to illustrate the on-station position of NASA's Synchronous Meteorological Satellite.

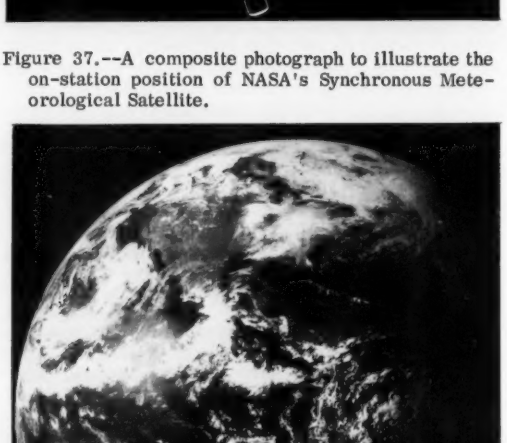

Figure 38.--The full disk of Earth is not quite visible in this SMS-1 photo of May 26, 1974, because the Sun was not high enough in the sky to illuminate the eastern part of the Western Hemisphere. However, the North and South American continents are clearly visible except where the solar terminator line darkens the eastern edge of South America. NASA

The data will be "stretched" for a lower data rate retransmission back through SMS to the NOAA Central Data Distribution Facility, Marlow Heights, Md., where it will be distributed to regional centers in Miami, San Francisco, Kansas City, Washington, D.C., and later Honolulu.

Data, including weather maps and pictures, can also be transmitted via the satellite directly to some 500 small Automatic Picture Transmission (APT) stations, most of which are in the Western Hemisphere.

A few months after the launch of SMS-1, another satellite, SMS-2, will be placed over the Pacific Ocean near 130°W. Present plans call for the launch of the Geostationary Operational Environmental Satellite (GOES) system, in the near future, which is the operational version of the SMS. In the late 1970's, the European Space Research Organization (ESRO), Japan, and the U.S.S.R. are expected to join the United States in providing meteorological satellites in synchronous orbit. The five spacecraft will be about 70° apart, spaced over the Equator around the world.

TRANSPORTATION FATALITIES, 1973

Transportation accident fatalities dropped slightly in 1973, but still exceeded 60,000, according to preliminary statistics released by the National Transportation Safety Board. The estimated 1973 total of 60,118 fatalities was 1 percent less than the 60,765 recorded in 1972.

Highway fatalities, perenially more than 90 percent of all transportation deaths, dropped 2 percent--from 56,700 in 1972 to an estimated 55,600 in 1973. Of this total, 54,385 died on the highways and 1,215 at rail-highway grade crossings. It was the first reduction since 1970, when the highway toll dropped 2.7 percent.

Most other modes of transportation recorded fatality increases in 1973. Lives lost in recreational boating were reported to have risen 22 percent, to an estimated 1,754, possibly due largely to more accurate reporting of such deaths in 1973. Airline fatalities rose 19.5 percent. Pipeline and railroad deaths were up 13 percent and 12 percent, respectively. Totals in other modes varied less than 10 percent.

The Safety Board's 1973 statistics were issued in the form of its annual pie chart of transportation fatalities (fig. 39). Included for the first time was a total for rail rapid transit--109 deaths--which had not been available in previous years. The new transit total includes the accidental deaths of passengers boarding and leaving trains.

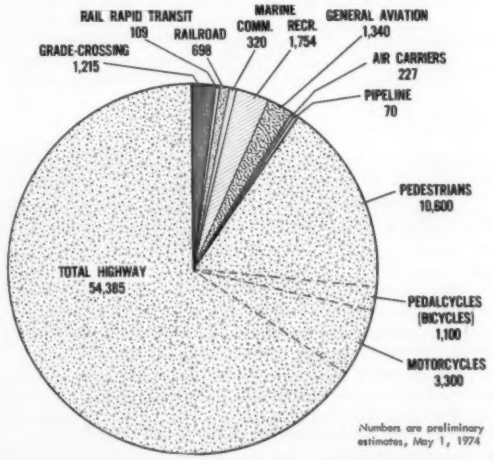

Figure 39.--Breakdown of the 60,118 transportation fatalities, 1973.

The estimated 1973 fatality totals by transport mode, with comparative 1972 figures in parenthesis: Highway--54,385 (55,440); rail-highway grade crossings--1,215 (1,260); railroad--698 (624); rail rapid transit--109 (--); commercial marine--320 (352); recreational boating--1,754 (1,437); airlines-- 227 (190); general aviation--1,340 (1,400); pipeline--70 (62).

NOAA SATELLITE INFORMATION AIDS SHIPPING, FISHERMEN, AND FLOOD FORECASTERS

Timely satellite information on ice in the Great Lakes and Alaskan waters, on the location of the Gulf Stream, and on snow cover in several major river basins is now available from NOAA.

Up-to-date ice observations help make maritime operations safer and more efficient, while information on the Gulf Stream can aid both commercial shipping and fishermen. Snow cover is an important factor in forecasting floods and estimating water supplies.

The experimental services, provided by NOAA's National Environmental Satellite Service (NESS), are based on detailed, half-mile resolution images obtained by very high resolution radiometer systems aboard polar-orbiting NOAA spacecraft.

To forecast future river flow and flooding and to estimate potential water supplies, hydrologists in many areas must take into account the amount of water stored as snow. In the western United States, seasonal snow accumulation is measured at thousands of surface locations, and aircraft are used to survey snow cover over large regions. But only the broader view from space can give a complete picture of the extent of snow cover.

Using high-resolution images, the extent of snow cover in river basins as small as 2,500 sq mi can be mapped to an accuracy of about 5 percent. A satellite image and a map of the river basin are placed in an optical device called a "zoom transfer scope," which enables the operator to see the satellite image superimposed on the basin map and to register the two. Snow areas appearing in the picture are traced on the map, the areal extent is measured, and the percentage of the basin covered by snow is calculated. The percentage figure is sent through National Weather Service communications systems to the NWS River Forecast Center responsible for predicting river flow, flooding, and potential water supply in the basin. This procedure is carried out each time a relatively cloud-free image of the basin is obtained, and is completed in 36 hr or less after the spacecraft has observed the area.

Each winter, sea, lake, and river ice closes ports and shipping lanes in high latitudes, forcing commercial vessels to remain idle and hampering military ship operations. To plan sea transport in these areas, marine interests need to know where ice exists in ports and along sea routes, and whether the ice is forming or breaking up. The United States, Canada, and other nations operate aircraft reconnaissance programs to gather this information. Although the reconnaissance is costly and complex, the economic savings and increased safety afforded to shipping operations have justified this expense. Now Earth-orbiting satellites permit more efficient aerial surveillance over vast areas.

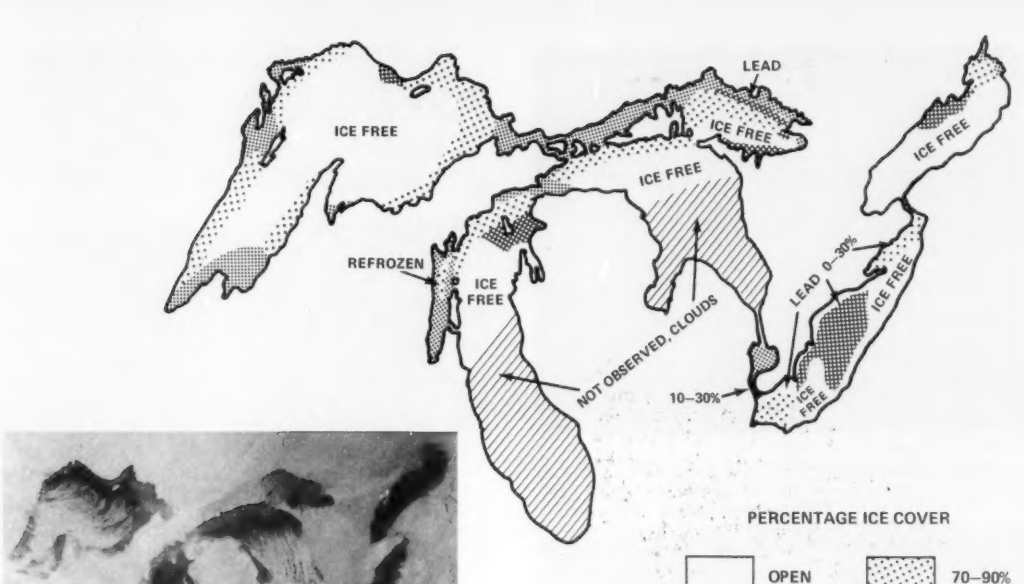

Figure 40.--Satellite pictures help in preparing analysis of Great Lakes ice charts which are sent by facsimile to ships.

Infrared sensing systems on the NOAA satellites allow major ice features to be observed throughout the year over the entire earth. Significant ice boundaries, openings, and thin areas can be detected in the images, and improved estimates of the thickness and physical state of the ice can be deduced from surface temperature information in the infrared images.

Ice charts (fig. 40) are prepared and disseminated through National Weather Service facsimile circuits on a regular schedule. Great Lakes ice analyses, issued twice weekly, show open water as well as areas where ice cover ranges from 10 to 30 percent, 40 to 60 percent, 70 to 90 percent, and up to 100 percent. Experimental ice analyses covering the Bering, Chuckchi, and Beaufort Seas and the Gulf of Alaska are issued weekly. These distinguish between new and multiyear ice and indicate estimated thicknesses of young and first-year ice in ranges of 10 to more than 120 cm.

Each week, NESS prepares and transmits an experimental Gulf Stream analysis chart, showing the surface location and extent of shelf water, slope water, the Gulf Stream itself, and associated cold and warm eddies, as revealed by surface temperature contrasts depicted in the high-resolution infrared images.

Information on the Gulf Stream is of special interest to the shipping and fishing industries. Ships plying East Coast routes make use of this large current to speed northbound runs and save fuel. Vessels heading southward stay clear of the Gulf Stream, which would slow their progress. The satellite data show the frequent meanders in the Gulf Stream.

Commercial fishermen can use the data on water-mass boundaries from these charts to increase the efficiency of their operations. The nutrients on which fish feed accumulate on the boundaries between shelf and slope water and between slope water and the Gulf Stream, and large concentrations of fish are usually found in such areas.

LORAN-C NAMED NATIONAL RADIONAVIGATION AID FOR U.S. COASTAL AND INLAND WATERS

A precision navigation system--Loran-C--has been named to replace Loran-A and to improve vessel traffic safety in the Nation's harbors, estuaries, and along the entire coastline from Maine to Alaska.

The announcement was made by the Coast Guard and the Department of Transportation during a demonstration of Loran-C aboard the Coast Guard Cutter MORGENTHAU in New York Harbor.

The growing volume of vessel traffic and the expected increase in the number of fixed structures, such as offshore drilling platforms, demand precise and accurate navigation by the mariner. With Loran-C, a vessel's position can be plotted to within 1/4 mi (500 yd). Loran-A, the system currently in commercial use, has only a 1/2 to 2 mi accuracy.

While Loran-C will cover the entire U.S. coastal confluence region--that area of water extending from the shore outward for 50 mi or to the 100-fathom mark, whichever is farthest--eight Omega transmitting sites will give worldwide coverage for the high seas. Two of these sites will be operated by the Coast Guard. The remaining six stations are located in other countries and will be operated by the host nation.

Loran, meaning "long range navigation," is a means for ships and aircraft to plot their position. Pulsed radio signals are sent out from a chain of three or more synchronized Loran transmitter sites. A mariner with a Loran receiver onboard takes a reading of the time difference between incoming signals from a pair of stations. This time difference figure is one point of reference. A second reading is taken on a different combination of transmitters from the same chain. The two time difference values identify Loran lines on special charts. Where these lines intersect is the vessel's location.

The first Loran, Loran-A, in wide use today, was developed during World War II and has changed little since. Users of Loran-A include commercial fishermen, shipping companies, aviators, and pleasure boaters.

Loran-C has been used by the military since 1958. Because of its high cost, civilian usage has been limited to some scientific and oil exploration groups. However, recent advances in micro-electronics have now made it possible to produce and sell "C" receivers at a price attractive to the commercial user.

The low-cost Loran-C receivers being manufactured are compact and simple to run. To operate, turn on the power switch and dial in code values for the Loran chain in the area and selected pairs of transmitting signals. Within seconds, time difference readings are flashing on a lighted panel. The current price of the "C" receivers range between $3,000 and $4,000. The cost is expected to decrease as production and demand for equipment is stepped up.

Loran-C signals travel 1,200 to 1,500 mi, compared to Loran-A's 700- to 900-mi range. Due to wider coverage, transmitters in the "C" chain can be placed further apart. Fifteen "C" stations can cover the U.S. coastline from Maine to Alaska; it takes 30 "A" sites to blanket the same region, with less range to seaward. Loran-A is accurate to within 1/2 to 2 mi; Loran-C is accurate to within 1/4 mi. With "C," a mariner can return to a previous Loran-C identified position within 50 ft. Or, in the instance of the fisherman who has lost his net to an underwater obstacle, Loran data can be used to avoid that area in the future. Loran-C can operate under all weather conditions, while Loran-A signals are often disrupted by atmospheric disturbances.

Vessels will be able to follow a more accurate course with Loran-C plotting, by accounting for known ocean currents, therefore cutting down on travel time between points.

A transition period of 5 yr will be provided before any continental U.S. Loran-A stations are closed down. Additionally, a 2-yr operational overlap with both systems on the air in any given area will provide time for users to amortize their old Loran-A equipment and convert Loran-A data to Loran-C coordinates.

The establishment of a complete Loran-C system will be in four phases. The first phase will begin with the construction of five stations along the West Coast from California to Canada. These sites are expected to be in operation in time for the first of the tankers carrying oil from the Alaska Pipeline terminus at Valdez down the Pacific coast in 1977.

Phase two will be the operation of three new "C" sites in the Gulf of Alaska in 1978. The operation of three new stations in the Gulf of Mexico and one additional site to fill out the East Coast will conclude phase three in 1979. The final phase will be the completion of a "C" system in the Great Lakes in 1980, During the period 1974 through 1980, improvements and modifications will be made to existing Loran-C stations.

Presently, there are five Loran-C stations on the East Coast, stretching from Cape Race, Newfoundland, south to Jupiter, Fla., and four "C" sites in Alaska. The Cape Race station is Canadian operated. The United States is working along with the Canadian Government in locating other Loran-C stations in Canada that would interface with American-operated stations.

There are many uses of the Loran-C system because of its high precision and reliability. In harbors with vessel traffic systems, Loran-C can aid in monitoring vessel movement, thereby helping to avoid potential collision situations. Loran assist devices can guide aircraft in for landings in zero visibility. More accurate nautical charts can be mapped, especially in the pinpointing of locations of wrecks and shoals. Because Loran-C can be used over land, it can be applied to finding vehicles, be they in rough terrain or in a city. Loran-C's microsecond radio pulses make it the most precise means of synchronizing timepieces. As Loran-C becomes available commercially, the versatile list of applications will grow.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

LETTERS TO THE EDITOR

ENCOUNTER WITH TYPHOON LOUISE

Capt. R. G. MacDonald of the 9,474-ton TREDAN submitted the following information on an encounter with typhoon Louise, on September 3-4, 1973, in the South China Sea. E. W. K. Chu, of the Royal Observatory, Hong Kong, was kind enough to forward copies of the information to the Mariners Weather Log (figs. 41-43).

Louise developed as a depression on September 1, east of the Philippines. She tracked northwestward and then turned westward to cross in front of the TREDAN on the 3d, reaching typhoon strength on the 5th, with 75-kt winds and minimum pressure of 974 mb. On the 7th, Louise dissipated over North Vietnam. See page 236 of this issue for a more detailed discussion.

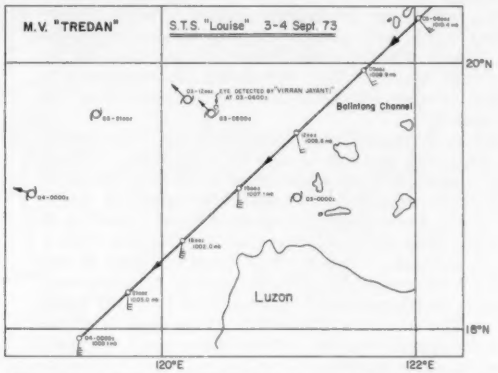

Figure 43.--Track of TREDAN's encounter with Louise.

Severe Tropical Storm "Louise"

South China Sea — 3rd ~ 4th September 1973

First indications of this storms developement was noted when it was in depression form in Posn 13°N 134°E.
Physical indications of the storm were watched for & first indications were a growing swell from 170° at 03-0000z. Track of the storm was kept & indications were it was a compact storm. The 0844z-3rd message from "Vikram Jayanti" [VWTW] giving eye position at 0630z was invaluable as other than rain in the area little indication of storm was observed at "Tredan"
Vessel commenced encountering heavy rain & freshening winds at 03-1400z & by 03-1800z was being lashed by Force 9 winds often gusting >50knots, torrential rains & heavy seas.
Being deeply laden the vessel apart from slipping heavy seas had a comfortable passage across the stern of the storm. By 04-0000z conditions had moderated although wind was still fresh & vessel continued on passage out of storm influence area.

Observers: R. G. MacDonald. Captain
H. Ebeltwite. c/o
I. R. Mir 3/o

Figure 41.--Log of TREDAN's meeting with typhoon Louise.

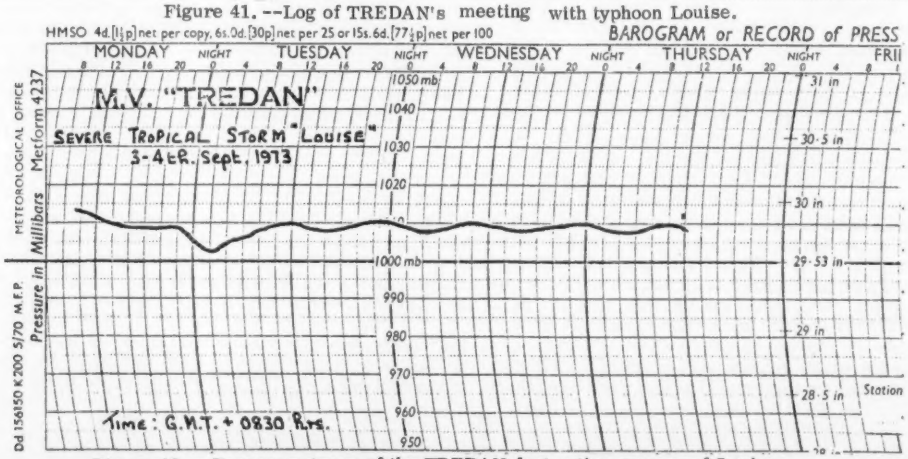

Figure 42.--Barogram trace of the TREDAN during the passage of Louise.

QUEEN ELIZABETH 2 REPORTS ON CURRENTS SOUTHWEST OF BERMUDA

The following letter was forwarded to the Editor from R. W. Warwick, First Officer of the QUEEN ELIZABETH 2. The QE2 broke down about 200 mi southwest of Bermuda. Its subsequent drift is a good indication of currents in the area.

"At the beginning of April, the QE2 was stopped in the Atlantic for 4 1/2 days. During this time, it was possible to observe the ocean currents that exist in the Bermuda area.

"For your possible interest, I enclose a drawing (fig. 44) which shows the drift experienced. The draft of the ship was 30 ft, and the height of the bridge above the waterline is over 90 ft. It is interesting to note that despite the considerable 'sail area' and the fact that the winds were mainly southerly, the ship drifted to the northeast at about 1 kt.

"Positions on the plot were established by Omega and Satellite navigation equipment."

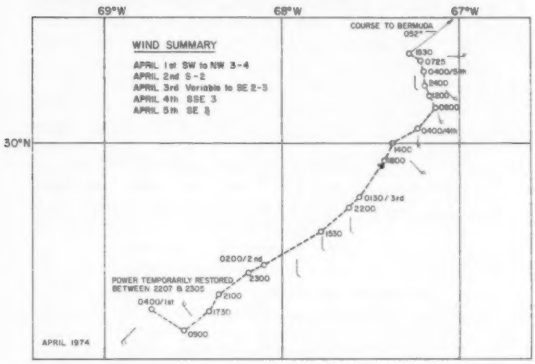

Figure 44.--Northeasterly drift of the QUEEN ELIZABETH 2, between April 1-5, 1974.

Table 5. --Log abstract of the QUEEN ELIZABETH 2, April 1-5, 1974

Date	Time	Position	Wind (Beaufort)
Apr.			
1	0400	29°14'N, 68°44'W	SW, 3-4
1	0800		NW, 3-4
1	0900	29°08'N, 68°34'W	
1	1200		NW, 3
1	1600		SW, 3
1	1730	29°14'N, 68°24'W	
1	2000		Light airs
1	2100	29°18'N, 68°21'W	
1	2300	29°24'N, 68°11'W	
1	2400		Light airs
2	0200	29°26'N, 68°06'W	
2	0400		Light airs
2	0800		S, 2
2	1200		S, 2
2	1530	29°35'N, 67°47'W	
2	1600		S, 2
2	2000		S, 2
2	2200	29°42'N, 67°37'W	
2	2400		S, 2
3	0130	29°45'N, 67°34'W	
3	0400		Variable, 1-2
3	0800		Variable, 2
3	1200		NE, 2
3	1600		Light variable, 1-2
3	1800	29°55'N, 67°25'W	
3	2000		SE, 2
3	2400	30°00'N, 67°22'W	SE, 2-3
4	0400	30°04'N, 67°14'W	S, 3
4	0800	30°10'N, 67°08'W	SxE, 3
4	1200	30°13'N, 67°10'W	SSE, 3-4
4	1600		SE, 3
4	2000		SSE, 3
4	2400	30°16'N, 67°11'W	SExS, 3
5	0400	30°20'N, 67°12'W	SE, 3
5	0725	30°23'N, 67°13'W	
5	0800		SxE, 3-4
5	1200		E, 3
5	1530	30°15'N, 67°17'W	
5	1600		SSE, 3

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

MARINE WEATHER REVIEW

Table 6

U. S. Ocean Station Vessel Climatological Data, North Atlantic

Annual Summaries--1973

Ocean Weather Station "BRAVO" 56°30'N 51°00'W

MEANS AND EXTREMES																										
DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)					PRESSURE (MB)				
MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE
-12.8	02/11*	3.3	13.4	07/25	-17.9	02/18	0.5	10.8	07/20	1.1	12/12*	5.5	13.3	07/31	-16.1	01/18	-2.2	5.6	07/12	975.3	01/16	1008.0	1038.3	01/12

CLOUD AMOUNT (OKTAS) PERCENTAGE FREQUENCY								DAYS WITH SPECIFIED WEATHER									MAX WIND (KTS)			MAX WAVE HEIGHT (MTRS)			TOT NO OF OBS
TOTAL CLOUD				LOW CLOUD				RAIN OR				VSBY	WIND (KTS)										
0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	DRZL	SNOW	TSTM	<1KM	≥34	≥48	≥64	DIR	SPD	DATE	HGT	PER	DIR	TYPE	DATE	
3.4	9.1	25.8	61.6	11.2	15.6	29.1	44.0	256	246	127	0	67	96	9	1	060°	70	02/23	16.0	10	250°	SWL	11/23	2585

Ocean Weather Station "CHARLIE" 52°45'N 35°30'W

MEANS AND EXTREMES																										
DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)					PRESSURE (MB)				
MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE
- 2.8	03/03	8.2	15.5	08/30	-11.8	03/03	5.5	14.8	07/25	1.7	02/19	8.6	15.4	07/25*	- 8.5	01/19	-0.5	8.1	02/19	963.0	01/13	1012.6	1040.7	02/22

CLOUD AMOUNT (OKTAS) PERCENTAGE FREQUENCY								DAYS WITH SPECIFIED WEATHER									MAX WIND (KTS)			MAX WAVE HEIGHT (MTRS)			TOT NO OF OBS
TOTAL CLOUD				LOW CLOUD				RAIN OR				VSBY	WIND (KTS)										
0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	DRZL	SNOW	TSTM	<1KM	≥34	≥48	≥64	DIR	SPD	DATE	HGT	PER	DIR	TYPE	DATE	
5.3	11.2	21.4	62.1	13.5	21.1	22.4	43.1	265	263	35	0	107	104	9	1	210°	65	10/23	11.5	8	220°	SEA	10/23	2670

Periods in Seconds

Complete Data For Ocean Weather Stations "DELTA", "ECHO", and "HOTEL" Not Available

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Table 7

U. S. Ocean Station Vessel Climatological Data, North Pacific

Annual Summaries--1973

Ocean Weather Station "NOVEMBER" 30°00'N 140°00'W

MEANS AND EXTREMES																										
DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)					PRESSURE (MB)				
MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE	MIN	DATE	MEAN	MAX	DATE
13.7	02/22*	19.4	28.3	09/11*	5.2	02/02	14.6	25.0	09/01	16.0	02/24*	20.4	24.4	10/30*	- 5.7	11/12	-1.0	6.4	05/30	1002.0	02/04	1023.1	1034.1	03/12

CLOUD AMOUNT (OKTAS) PERCENTAGE FREQUENCY								DAYS WITH SPECIFIED WEATHER									MAX WIND (KTS)			MAX WAVE HEIGHT (MTRS)			TOT NO OF OBS
TOTAL CLOUD				LOW CLOUD				RAIN OR				VSBY	WIND (KTS)										
0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	DRZL	SNOW	TSTM	<1KM	≥34	≥48	≥64	DIR	SPD	DATE	HGT	PER	DIR	TYPE	DATE	
15.0	20.9	37.4	26.7	24.6	22.2	29.3	23.9	166	165	0	1	0	19	2	0	280°	55	02/27*	9.0	9	280°	SEA	02/27	2414

Periods in Seconds

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Smooth Log, North Atlantic Weather

January and February 1974

The SMOOTH LOG (complete with cyclone tracks [figs. 45–48], climatological data from U.S. Ocean Station Vessels [tables 8–9 and 11] and gale tables 10 and 12), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, JANUARY 1974--The cyclones of the North Atlantic this month were normal in number and in the paths their centers traced. The normality ended there, though, as they were much lower in pressure and more intense. Casualties were high this month. The primary tracks were across southern Canada to Iceland, and from the midwestern United States northeastward over and south of Newfoundland to Iceland and the Norwegian Sea. One vicious storm broke the pattern and crossed the North Sea. Only one significant cyclone entered the Mediterranean Sea.

The mean pressure pattern for the month was definitely dominated by the Icelandic Low, located near 60°N, 27°W, with a pressure of 973 mb. This mean must be very close to a record. The normal is 999.7 mb, resulting in a minus 27-mb anomaly, centered with the Low. Not only was the Icelandic Low more intense, the Azores High was higher in pressure at 1027 mb, and covered more area in the east-west direction. The mean pressure over the United States was near normal, with relatively small anomaly centers. There were two positive anomaly centers of interest--a positive 6 mb, centered near 32°N, 53°W, that stretched northwestward over New England, and a positive 7 mb, centered over North Africa.

A large HIGH centered over the north-central United States dominated North America. A front lay across the southeastern United States. Several waves formed and moved northeastward along the front and dissipated. On January 1, one of these developed to sufficient strength to survive and, at 1200, was near Nantucket Island. By 1200 on the 2d, the 998-mb LOW was near Deadmans Point, Newfoundland. The drilling rig VGBZ reported 40-kt gales. At 0000 on the 3d, they were hit by 50-kt winds, as was a ship near 45°N, 49°W.

At 1200 on the 3d, the pressure had plunged to 962 mb near 53.5°N, 32°W. The DART AMERICA, near 44.7°N, 45.4°W, was mauled by 60-kt bow winds, driving 20-ft seas, and 30-ft swells. Vessels within 300 to 400 mi of that area combated 40- to 55-kt storm winds and high waves up to 26 ft. Some of them were the ATLANTIC STAR, COLLIN, EUROFREIGHTER, DFQA, KJVG, VC8062, and the VGBZ. Twelve hours later, many of the same ships were still battling the angry elements, especially if they were headed east. The COLLIN now had 60-kt winds. The seas were 33 ft, with 25-ft swells from the west. The CRANIA, 400 mi to the east near 41°N, 35°W, was being battered by 50-kt westerly winds and 36-ft swells and 12-ft seas on her northeasterly course.

Near the center, new centers were forming and moving around each other, becoming the main center as they developed.

At 1200 on the 4th, the pressure of one of these new centers had dropped to 948 mb, southwest of the previous center. These new centers deepened as they moved under the upper-air LOW and dissipated as they moved east and north. Two ships reported 60-kt almost hurricane-force winds, and both were ravaged by 32-ft swells and seas to 15 ft. They were the COMORANT, near 41.3°N, 35.8°W, about 700 mi due south of the LOW, and the DFQA, north of Belle Isle. Other ships reporting 50- to 55-kt winds in a band stretching from the Bay of Biscay to Newfoundland were the AFOUNDRIA, ATLANTIC STAR, IDEFJORD, LASH TURKIYE, MANCHESTER COURAGE, HORSE RIVER, PEGASUS, ULTRAMAR, WESER, and FNVD. The IDEFJORD reported the high waves near 51°N, 46°W--35-ft seas and 40-ft swells. The ULTRAMAR encountered the highest swells, which were 47.5 ft, near 39.9°N, 31.4°W. The seas were 20 ft at the time, with 58-kt winds.

The LOW was near 62°N, 24°W, at 0000 on the 5th, at a pressure of 946 mb. Storm winds were still blowing in the southern quadrants, and gale-force winds had now picked up in the northern quadrants. The CETRA COLUMBA now joined the 60-kt exclusive club. The BERTHA FISSER reported 41-ft seas, near 42.8°N, 21.5°W.

For the next 2 days, ships seemed to either avoid the high wind band or there were no reports in that area. On the 7th, the LOW was slowly filling, and there were more reports plotted. The MABEL WARWICK, at about 47°N, 39°W, found 50-kt storm winds. The 17,189-ton TRENTON, Bremerhaven to New Jersey, had heavy weather damage. On the 8th, the 5LBA was swept by 60-kt winds, south of Kap Farvel. The various LOWs near the center continued to interchange until the 9th, when a new storm came off the continent to become the dominant cyclone.

This new LOW formed north of Minnesota on the 7th. Forty-eight hours later, the LOW (980 mb) was northeast of St. John's. A report, which was probably SEDCO I, indicated 50-kt winds. This 961-mb LOW turned northward and another 970-mb LOW formed near the occlusion prior to 1200. It raced to near 53°N, 25°W, at 961 mb, by 0000 on the 10th. The winds in that 40° to 55°N latitude belt roared again.

The drilling platform VC8062 measured 60-kt winds. The ships reporting 50-kt winds were getting too numerous to mention. The C. V. LIGHTNING, at 45.1°N, 30.5°W, was ravaged by 60-kt winds, 16-ft seas, and 52-ft swells. The FERNGULF, at 47.5°N, 26.3°W, was ravaged by 64-kt winds, with 32.5-ft seas. Further north, near 52.5°N, 20°W, Ocean Station Vessel "J" measured 65-kt hurricane-force winds at 1200 on the 10th, and stared into 26-ft seas and 33-ft swells. The winds at Ocean Station Vessel "I" changed from easterly at 55 kt at 0900 to south-southeasterly at 45 kt at 1200. Her pressure was 942 mb, having dropped over 11 mb in 3 hr. At 1200, "I" was very near the center of the storm. The seas were 25-ft and the swells 39 ft, with the direction indeterminate. The LOW remained near OSV "I" until 0600 on the 11th, when it started to move northward as another LOW moved around the southern edge of the circulation. The minimum pressure was 938 mb at 1200 on the 10th. Two ships, the AMERICAN ACE, at 50.2°N, 17.5°W, and the AUSTRALIC, at 46.5°N, 13.8°W, both reported 49-ft seas, with winds of 55 and 45 kt, respectively. Seas over 20 ft and swells over 30 ft were common occurrences. This LOW had disappeared by 1200 on the 12th.

A high-pressure area moved eastward out of the United States midwest on the 8th and 9th. As it moved off the East Coast, a LOW formed over Chesapeake Bay. On the 10th, the HIGH split into two centers, one over the St. Lawrence valley and the other southeast of Bermuda. The LOW moved between the two high centers, and, at 1200 on the 10th, was near 38°N, 45°W, on the edge of the major cyclonic circulation of the Icelandic Low. The HEILBRONN and TILLIE LYKES were south and southwest of the 1010-mb center with 40-kt gales.

By 1200 on the 11th, the pressure had plunged to 968 mb, a 42-mb drop in 24 hr. The LOW was near 46.5°N, 22.5°W, and pulling the circulation from the last described LOW south of 50°N. The FERNGULF was headed southward, but still was fighting 60-kt winds and 39-ft seas near 44.7°N, 26.4°W. The EXPORT LEADER, near 41.6°N, 38.9°W, fought 59-kt winds, and the SEALAND MCLEAN battled a 65-kt storm near 41.6°N, 28.9°W. Ocean Station Vessel "K" had 40-kt southerly winds, which switched to 45-kt westerlies 3 hr later. The WEATHER ADVISOR, at 0000 on the 12th, near 51°N, 15°W, reported 40-kt gales, as did the PEPECAT, near 47.5°N, 8°W. All that day, coastal stations on the west coasts of England and Ireland measured 30- to 40-kt gales. A 90-kt gust was recorded on the Isle of Arran, and a woman was killed near Glasgow when a wall collapsed on her. The Finnish motorvessel MARGARETA, Pasajes, Spain, for Canada, put into Vigo, Spain, on the 13th, to repair heavy weather damage to hatch covers and other damage.

The LOW was tracking north-northwestward into the Norwegian Sea on the 13th, and Ocean Station Vessel "M" was warmed by 40-kt southerlies. Over the cold water and ice near Jan Mayen Island, the LOW disappeared.

Monster of the Month--This marine monster could not be found on the 1200 chart of the 14th with the available data. At 1800 on the 14th and 0000 on the 15th, there was no doubt of its existence. At 0000, it was a well-defined 1006-mb LOW near 43.5°N, 36°W. By 1200, it was 996 mb, at 47°N, 28°W. The GERDA MARIE was 150 mi southwest of the center and hit by 50-kt gales. Two other ships found 40-kt gales, but could not be identified. The storm was headed northeastward toward the United Kingdom and North Sea. Ocean Station Vessel "K" measured 45-kt gales and "J," 35-kt gales, as the storm passed between them. At 1200 on the 16th, the 980-mb LOW was over Ireland. A Russian ship reported 55-kt storm winds and 30-ft seas at 49.1°N, 11.2°W. The ATLANTIC CHAMPAGNE radioed 60-kt violent winds near 49°N, 16°W, but there were no seas plotted.

These destructive winds were an indication of what hit both sides of the English Channel that day and the next. Winds were reported as high as 87 kt (100 mph) and seas up to 50 ft battered both sides of the channel. British authorities reported at least 25 dead and 5 missing. French officials said at least nine persons died on the continental side of the channel. At least eight small ships capsized or were blown into reefs in the high seas. Many homes were damaged and grounded powerlines blacked out thousands of homes on the east coast of England. Dunkirk and other coastal cities reported heavy damage. The West German coast was lashed by winds over 50 kt, and roofs were blown off as far inland as Duesseldorf.

The 2,088-ton Cypriot freighter PROSPERITY was blown aground on a reef off Guernsey and broke up, with the loss of 18 men aboard. Another eight seamen drowned and three were missing when the 781-ton Danish MERC ENTERPRISE capsized off the coast of Devon. In Exminster, along the same coast, a giant wave washed a 13-yr-old boy out to sea and he drowned. Six fishermen and a 16-yr-old girl perished off Brest when waves overturned three small boats. A crewman was washed overboard and lost from the Swedish cargo ship ELIZABETH (494 tons). Off the Netherlands, helicopters rescued seven crewmen from the Lebanese coaster CORDELLA, after it ran aground on a sandbank. Another Cypriot ship, the MARTA (2,240 tons) reported a fire off the Belgian coast, which took one life. A French trawler, the KERIOLET, radioed a distress call off the Bristol Channel. The ELWOOD MEAD (59,200 tons) still lay stranded over her full length on a reef off Guernsey. This may have been the storm that caused heavy weather damage to the British DART AMERICA (31,036 tons) on her Antwerp to Halifax voyage. The 669-ton British supply vessel EAST SHORE was abandoned on the 17th, near 42°N, 4.9°E, with a heavy list and deck cargo lost. The towline snapped after being taken in tow. The crew took to a lifeboat which drifted away and could not be located by search aircraft and ships. Three bodies were found later, and three men were missing.

At 1200 on the 17th, the LOW was over southern Sweden and, on the 18th, moved through Poland to disappear in Russia. Strong winds and high seas continued as they swept around the general Icelandic Low circulation with a long fetch. On the 18th, high pressure moved into the Bay of Biscay, moving the strong circulation northward.

This storm formed east of Cape Cod on the 17th, on a

front connected with a LOW which was over Kap Farvel at that time. Strong storm winds of 40 to 50 kt were already associated with that LOW. The center raced eastward and, by 0000 on the 18th, was 982 mb, near 44.5°N, 44.5°W. The WILLIAM R. ADAMS, just a few miles from the center, near 43°N, 47°W, reported a roaring 80-kt wind from the east. The wave heights were missing from the plotted and teletype report. At the same time, the ATLANTIC COGNAC, southwest of the center near 40.5°N, 59°W, came up with a 90-kt report on the chart, which did not exactly agree with her 10-ft seas report. There may have been some garbling between the taking and the plotting of the weather. The BLEXEN, south of the center near 38.5°N, 45°W, was battered by 55-kt winds and 23-ft waves.

The LOW moved northeastward, deepening to 970 mb near 51°N, 39°W, 12 hr later. SEDCO J measured a roaring 60-kt wind and the C. P. DISCOVERER found the same isotach east of the LOW near 50.5°N, 29.5°W. She also reported 43-ft seas and 26-ft swells. There were 40- to 50-kt reports in all directions except north of the center. By 1200 on the 19th, the LOW was a 965-mb depression near 58.5°N, 34°W. The ATLANTIC CHAMPAGNE, about 900 mi to the south near 45°N, 35°W, was hit by 60-kt winds and 33-ft seas.

On the 19th, a LOW moved eastward over Nova Scotia and another LOW formed south of the main center. These two sapped the strength of the old LOW as it stalled south of the Denmark Strait and disappeared on the 21st.

This was the LOW mentioned in the paragraph above that moved over Nova Scotia. It had its beginning over the State of Indiana early on the 19th. By 0000 on the 20th, it was a 986-mb depression south of Sydney. The CAVALA reported 40-kt gales and 15-ft waves south of Sable Island, which also recorded 40-kt gales. Twelve hours later, SEDCO I was pounded by 50-kt winds and confused waves up to 12 ft. The ATLANTIC CHAMPAGNE was again swept by 60-kt winds and 30-ft seas and swells, about 420 mi south of the 971-mb center, which was near 51°N, 42°W, at 0000 on the 21st. The TACOMA CITY, at 45°N, 36.5°W, was mauled by 60-kt winds and 25-ft seas and swells just east of the cold front. Forty- to fifty-knot winds were common occurrences between 45° and 50°N and 20° to 50°W. This LOW forged its way as far north as Iceland before splitting into two centers, one on each side of the island.

A LOW developed over Missouri late on the 26th and moved northeastward across Lake Huron. High wind warnings were posted for up to 45 kt over lower Lake Michigan and western New York bordering Lakes Erie and Ontario. By 0000 on the 28th, about 30 hr later, it was over the Gulf of St. Lawrence at 983 mb. SEDCO H radioed that the winds were blasting it at 60 kt. They weren't nearly as bad off as the observatory atop Mt. Washington in New Hampshire. They recorded an average speed of 64-kt with maximum gust of 122 kt, on the 27th, as the LOW passed to the north. That was the highest average speed and gust for the month, although they had gusts over 100 mph on 10 days of the month. At 1200 on the 28th, the 974-mb LOW was near 50°N, 44°W. The SATSUMACORE, at 43.1°N, 44.4°W, was struggling against 60-kt storm winds. The DART AMERICA had no less a struggle as the front passed near 44°N, 40°W, with 55-kt winds and 16-ft seas riding 40-ft swells. The ONOMICHI MARU was in unfriendly foreign waters just south of the center, with 50-kt gales and 16-ft seas and swells. There were three major LOWs between Newfoundland and Norway at this time. Gale- and storm-force winds were reported from shore to shore. The 4,576-ton Greek motorship CAPTAYANNIS dragged anchor on the Clyde, struck the 22,783-ton British tanker BRITISH LIGHT and holed her, then grounded and lay half submerged in heavy seas. Twelve hours later, the DART AMERICA still fought 55-kt winds and the swells had increased to 46 ft. The ADMIRAL W. M. CALLAGHAN, at 39.9°N, 34.2°W, fought 60-kt winds at 0600 on the 29th. The NAGANO made two reports of 55-kt winds in the next 30 hr. The DAPHNE, to the southeast of the LOW, near 41.7°N, 21.3°W, was pounded by 39-ft seas from the southwest and 44-ft swells from the northwest. This LOW had traveled a more southerly route, but eventually turned northward to stall and dissipate just south of Iceland by February 1.

This was another contribution the United States midwest made to the Atlantic this month. It started late on the 27th and was the next system after the previous one to take to the sea. The LOW moved off the coast near Long Island about 0600 on the 29th. Several ships found a mere 40-kt wind as it moved over the Banks to Cape Race.

After passing from over the Labrador Current to over the Gulf Stream, it deepened rapidly to 973 mb, near 48°N, 39°W, at 1200 on the 30th. The INO-A, at 43°N, 40°W, was buffeted by 60-kt winds and 26-ft seas. As the storm raced eastward, the LE SAVOYARD, at 0000, had a 60-kt glimpse of what was to come later in the day. The seas were 40 ft. On the 31st at 0600, the CARMEN, near 46°N, 27.5°W, was hammered by 65-kt hurricane-force winds. At 1200, the BABETTE JACOB, near 43°N, 22°W, and the BEL-HUDSON, near 42.7°N, 21.7°W, were both ravaged by the same 65-kt force. The BEL-HUDSON reported 20-ft seas and "71-ft" swells. The MOORDRECHT, near 44°N, 29°W, had only 45-kt gales, but was being hounded by 52-ft following seas. Thirty- to forty-foot waves were a common report in the southwest quadrant of the LOW. Ocean Station Vessel "K" was tossed by 40-kt winds and the seas had built to 39 ft. Twelve hours later, "K" had 45-kt westerly winds, 46-ft seas, and 16-ft swells from the southwest.

The LOW was moving slowly towards the northeast on the 2d. The EWMR was hit by 50-kt gales south of Iceland and west of Scotland. Later in the day, the THERON, off Portugal, was also in the 50-kt wind band. The LOW moved to near the Shetland Islands on the 3d and dissipated.

The ancestry of this LOW is traceable back to Montana, early on the 30th. It formed slightly on the back side of the upper-air trough and under the jetstream. Its development was rapid, and it raced eastward with the zonal flow. At 1200 on the 31st, it was south of James Bay at 985 mb and the circulation had reached the Northeast. That day, some coastal stations reported

the fastest wind for the month. The time of day was not reported, but was probably late, as the wind direction was northwesterly. Blue Hill Observatory, Mass. (629 ft), had 62 kt, and the forecast office at Boston had 53 kt.

On February 1, the 962-mb LOW had moved into Labrador and the strong winds were behind the cold front, out of the northwest. The GYPSUM QUEEN had 60-kt winds just south of Cape Sable. The VC8062 reported 70-kt winds, and, although the direction was wrong, the speed seemed reasonable considering the other reports and the pressure gradient. North of Sydney, the CRYOS had 50-kt gales. On the 2d, 50-kt winds were reported from Cape Sable north to Ocean Station Vessel "B," which fought 55-kt winds from the southeast. Kap Farvel was swept by 60-kt gales.

The pressure had decreased to 952 mb early on the 2d, but was rising on the 3d, as the LOW moved northeastward over the Labrador Sea. A new center developed near Kap Farvel on the 3d, and the original center became stationary over the Labrador Sea and disappeared on the 4th.

This was a very bad month around the Mississippi River Delta and southern Louisiana, including New Orleans, for fog. Cold water from the river, near 40°F, fans out through the delta to the east, south, and west, and spreads along the coast. There is more of this cold water this year than normal, for there has already been flooding along the river. When warm, moist air flows northward from the Gulf of Mexico over this cold water, dense fog occurs and spreads inland. When the winds are light and over the colder ground, the fog often persists for long periods.

During the period of January 7 to 20, there were several days of heavy fog. There were 112 ships delayed during the first week and 78 ships delayed the second week, on both sides of the passes at the mouth of the river. The high water and swift currents intensified the problems as more than 150 barges broke loose in the Port of New Orleans, in three separate incidents, causing damage to ships and docks before they were secured. On the 16th, about 139 barges broke loose and floated down the river. Eighty-four reportedly held grain, some were empty, but one contained fuel oil. New Orleans main bridge was closed, as was ferry service. Three wharves and several ships were damaged, including the USCGC POINT SPENCER. Grounding was a common occurrence, as the fast currents changed channels and fog made navigation difficult. There were six groundings noted during this period alone that were probably at least partially attributable to fog.

The 22,311-ton Norwegian ore carrier BAUNE, loaded with bauxite, and the 11,476-ton United States tanker KEYTRADER collided on the Mississippi River near Venice, La., on the 18th. Both vessels caught fire, and burning fuel oil floated down the river. Five crewmen were killed, eight injured, and eleven missing. Fog hindered the rescue operations. See item "Fire, Foam, Ferries, Oil, Barges, and a River," on page 246, for a more detailed description of Coast Guard operations during this emergency on the river. On the 23d, the Greek motorvessel THEANTO A. S. (9,602 tons) ran aground on soft sand at low tide in fog. To the east of the Mississippi Delta, the Japanese NICHIKU MARU grounded in the Mobile Ship Channel on the 22d, in dense fog. On the last day of the month, the TEXACO FLORIDA (12,802 tons) ran aground in the southwest pass of the Mississippi River in fog, which stopped all movement in or out of the river port.

Casualties--This was not a good month. Fog took its toll in other areas besides the Gulf Coast. The United States tanker GULFSPRAY (18,150 tons) and the Norwegian motorship KOLLGEIR (20,455 tons) collided in fog about 4 mi from the mouth of the St. Johns River. The GULFSPRAY went aground about 1/4 mi off Mayport, Fla. The Liberian-registered ARIZONA, on a voyage from Canada to Jamaica with a cargo of steel, arrived in Georgetown, S. C., with number 2 tween deck collapsed, due to heavy weather.

The motorvessel DETROIT EDISON and the steamship HENNEPIN were both stuck in ice and possibly aground 9/10 mi north of the Detroit River Light in Lake Erie. Both were downbound and were freed on the 9th, proceeding to Toledo for winter layup.

The 2,648-ton Sharjah AL RIAZ sank near 44.6°N, 8.9°W, on the 5th, taking water in rough weather. The 1,401-ton MARDINA REEFER ran aground in heavy weather near Port Harmon. The 1,076-ton Liberian LADY JEAN ran aground during a gale on the 10th, at Peterhead, and was later towed to River Tyne. Earlier on the 4th, the 686-ton trawler NURZEC was stranded north of Aberdeen during a gale. Salvage tug GORDYY launched a liferaft with five men on board to rescue the crew. The raft capsized, and three crewmen of the trawler and one from the tug died. The 13,252-ton BRITISH FERN and the 12,279-ton SAINT MARY collided in fog about 41.1°N, 9.9°W, on the 14th. Both suffered extensive damage.

The South African motorvessel S. A. WELTEVREDEN (7,002 tons) hove to in a storm and the deck cargo shifted, about 350 mi southeast of Philadelphia on the 10th. The Panamanian-registered CAPE BRETON arrived in Jacksonville from Antwerp on the 22d, with heavy weather damage. The Greek KEA (13,000 tons) ran out of fuel in the Atlantic. It broke its towline in heavy seas on the 15th, about 210 mi southeast of Norfolk. The Cypriot EXPRESS II (976 tons) ran aground in heavy weather 40 mi west of Alexandria on the 17th. The Belgian LIBERATION (509 tons) capsized and sank in Brest Roads during heavy weather on the 27th. On the 28th, the Greek CAPTAYANNIS (4,576 tons) dragged anchor off Greenock, Scotland, during a gale, and collided with the BRITISH LIGHT.

The 7,782-ton Greek steamer IRA and the 8,768-ton Uruguayan motorship TACUARI collided at Haifa in stormy conditions on the 29th.

Two persons drowned and four were rescued when the 61-ft schooner SADIE AND EDGAR struck a sandbar and broke up off Atlantic City, N. J. The tanker PROVIDENCE GETTY spotted the four in an 11-ft skiff and rescued them.

SMOOTH LOG, FEBRUARY 1974--The cyclone paths across the North Atlantic were more widely distributed this month than normally. The major tracks out of North America were reversed. The primary

track was more easterly across the central United States, and the secondary track was up the St. Lawrence River valley. As the centers crossed the East Coast, they retained the more easterly direction; therefore, the average track was further south in the central Atlantic and closer to the United Kingdom, rather than Iceland, as it neared the European area. There was the normal number of cyclones in the Mediterranean Sea area, but none were severe.

The 30-day mean pressure pattern was near normal, at least in configuration. The Icelandic Low was about 400 mi due east of its 1004.3-mb climatic position, near 60°N, 28°W, at 993 mb. The Azores High was normally located, but about 4 mb higher than the usual 1020.6 mb, at 1025. The pressure over the central eastern United States was slightly below normal.

Compared to last month, the anomalies were small. There were several significant ones, though. There was a minus 12-mb center near 60°N, 20°W, that reflected the eastern displacement of the Icelandic Low. Another minus 9-mb subcenter was off Labrador, near 44°N, 50°W, with an anomaly trough that overlay a pressure trough over Newfoundland and off the U. S. east coast. A minus 7-mb anomaly, near Sardinia, reflected the cyclones that passed over the Mediterranean Sea. The higher pressure over the midcentral North Atlantic resulted in a large positive 5-mb anomaly in that area.

There were no tropical cyclones this month, and none were expected.

The first storm of the month was born on the 1st over the Oklahoma Panhandle. It was fairly weak and diffuse until it crossed the coast near Cape Charles early on the 3d. Late on the 4th, the storm center turned northeastward, and, by 1200 on the 5th, was 976 mb, near 42°N, 62°W. The winds were blowing now. Two crewmen of the 18,669-ton tanker MOBIL FUEL were washed overboard and feared lost, 200 mi east of Cape Henry, in 35-ft seas and a heavy snowstorm. A Coast Guard airplane and a Navy helicopter searched for the seamen to no avail.

Winds of 45 kt were reported all around the storm by the BEL-HUDSON, HATTINGEN, MARGARET LYKES, and the MARIE L. BOLTEN. The highest seas were 16 ft, and swells, 33 ft. Just off Cape Breton Island, the LOUIS S. ST. LAURENT was beaten by 55-kt storm winds. Twelve hours later, the BOLESLAW SMIALY, 500 mi south-southeast of the center, was bounced by 50-kt winds, and the CARMEN, 320 mi south-southeast of the center, was headed into a 55-kt mauling. Gale-force winds stretched from the New Jersey coast to 40°W.

At 1200 on the 6th, the 976-mb storm was near St. Mary's Bay. This was a bad day on the western North Atlantic. The EXPORT LEADER felt the wrath of 70-kt winds and 30-ft seas near 38.7°N, 53°W. The BEL-HUDSON was struggling to stay afloat in 50-kt winds and 65-ft swells at 37.7°N, 53°W. The LASH TURKIYE, at 39°N, 59.6°W, was pounded by 50-kt gales, 30-ft seas, and 50-ft swells. The AMERICAN ARCHER (42°N, 60°W) and the LAKE EYRE (42°N, 57°W) both had 60-kt winds and 42-ft swells. The ELIZABETHPORT, MARIE L. BOLTEN, and the VC 8062 were still being hounded by 50-kt winds. Seas to 33 ft were common. The LAKE EYRE continued slowly westward into 55-kt, west-northwesterly winds, driving 40-ft seas and swells. The 9,085-ton DESPINA, Hamburg for Wilmington, N.C., arrived at Wilmington on the 6th with heavy weather damage. The Canadian 3,610-ton PRINDOC, Quebec for Santa Maria, returned when about 250 mi off Halifax, due to suspected heavy weather damage. On the 7th, the SIR HUMPHREY GILBERT was off Notre Dame Bay, fighting 50-kt winds. The EXPORT LEADER reported 75-kt winds at 0600 on the 7th, near 38.2°N, 53.6°W. The BEL-HUDSON still was looking at 65-ft swells.

About this time, a new LOW formed at the occlusion and moved eastward. The original LOW dissipated at 0600 on the 8th. While this was occurring, the highest winds reported were 45 kt. At 1200 on the 8th, the new 968-mb LOW was near 57.5°N, 18.5°W. Ocean Station Vessel "I" was hammered by 50-kt winds and 26-ft seas, as the center passed about 100 mi to the south. The speed of the LOW had slowed, and, 24 hr later, "I" was still receiving 40-kt gales. On the 10th, the LOW passed over the southern part of Sweden into the continent.

Back to the storm cauldron in the Midwest, on the 6th, a 1006-mb LOW bubbled over the southwest corner of Missouri. As the LOW neared the Appalachian Mountains, the center split, and a new LOW magically appeared near Long Island at 1200 on the 7th. Twelve hours later, it was stirring up 40-kt gales off the coast.

By 1200 on the 8th, the 988-mb center was near 43°N, 52°W, and the DART AMERICA was riding 50-kt winds and 23-ft swells. Gale-force winds continued to blow in the southern quadrant. At 1200 on the 9th, the 960-mb LOW was at 48°N, 31°W, and the HATTINGEN was overtaken by 60-kt winds.

The 956-mb storm center passed almost directly over Ocean Station Vessel "J." At 1200 on the 10th, the MANCHESTER ZEAL was hit by 50-kt gales. Ocean Station Vessel "I" was riding out 45-kt northerly winds, with 26-ft swells out of the northwest, as the LOW passed southeast of her position. The AMERICAN ACE, southwest of the center near 50.6°N, 27.5°W, had 60-kt winds and swells of 65 ft to match.

On the 11th, the LOW turned northward and, on the 12th, eastward, as the next LOW following behind sped south and then east of this one. The westerly movement brought 35- and 45-kt winds to the north coast of Iceland. On the 13th, she faded back into the witches' brew.

This was a product of the Hatteras storm factory. A wave formed on a front on the 8th, as it moved over the warm water of the Gulf Stream. It developed very rapidly, deepening from 1003 mb to 982 mb in 12 hr. The BEL-HUDSON was moving from one storm into another on her southeasterly track. By 1200 on the 9th, she had only managed to arrive at 37°N, 67°W, while still having 50-kt winds and 54-ft swells from 250°. The LOW was now under the zonal upper-air flow and racing eastward. The FROSTFJORD was near 39°N, 44°W, and was treated to 55-kt winds as the LOW passed about 180 mi to the north. At 1200 on the 10th, the FROSTFJORD still was battling 55-kt winds and keeping her wave heights a secret. The ERLANGEN was headed eastward at 25-kt, and the

LOW passed to the north, almost as if she was standing still, and left behind memories of 60-kt winds. The ALMERIA LYKES, at 42.8°N, 26.3°W, was pounded by 75-kt winds. The SEALAND VENTURE measured 68-kt winds and 32-ft swells. The KING ALFRED, 500 mi to the south, suffered 50-kt gales. The highest seas reported were now 30 ft. As the LOW approached the Irish Sea, the Brest Peninsula was pounded by 40-kt winds. The AMBOISE, off the Portuguese coast, found 50-kt gales along the front. The BELVAL also found 50-kt gales at 1200 on the 11th. The HOEGH MALLARD, at 43.5°N, 19.1°W, measured 65-kt winds, with no report of seas. The 20,187-ton Danish containership FALSTRIA lost her rudder about 40 mi south of Cork, while on her way from Hamburg to Vancouver. The Panamanian freighter LUTRIA was abandoned by its 28 crewmen near the Scilly Isles. The crew was rescued from lifeboats by Royal Navy helicopters.

The LOW continued its race across Scotland, but suddenly halted for an 18-hr rest off Vestfjorden, Norway, before moving on over Spitsbergen, to be lost over the Arctic Ocean.

As the last two LOWs moved northeastward over the eastern part of the ocean, an east-west trough line developed, stretching across Goose Bay toward Hudson Bay. A LOW developed northeast of St. John's at 0000 on the 10th and moved over Goose Bay by 1200. The MONT LOUIS, at the tip of the Gaspe Peninsula, reported 45-kt winds, and the HARENGUS, further up the St. Lawrence River, reported 40-kt blowing across the river. For the next 12 hr, the LOW was almost stationary, but the CRYOS was plotted on the chart just south of the Newfoundland coast with 70-kt winds. The air temperature was 16°F. At 1200 on the 11th, as the LOW moved eastward, the AMERICAN ACE, at 49°N, 40°W, was hit by 50-kt winds, 30-ft seas, and 33-ft swells.

It was on the 12th that one of the previous LOWs turned westward, and this was the demise of this LOW, as it was absorbed by the larger circulation.

This was another case of cyclogenesis over the Gulf Stream off Cape Hatteras, on the 11th. As usual in these cases, the LOW developed rapidly, and, by 1200 on the 12th, was 987 mb, near 38°N, 59°W. Gale-force winds were blowing in the south and west quadrants. Late on the 12th or early on the 13th, the LOW split into two centers, and the northeasterly one became the dominant storm. The KING ALFRED reported heavy rain with 45-kt winds. Later in the day, on the 13th, the 967-mb storm was really winding up. The C.P. DISCOVERER was within 60 mi of the center, reporting 40-kt winds. To the south, the PANDO GULF found the same speed. In the warm sector southeast of the center, the LEONID KRASIN had 45-kt gales. About 600 mi southwest of the center, the KING ALFRED was still involved with 50-kt storm winds. The 4,311-ton Greek motorvessel MARGETINA was disabled due to fuel contamination caused by violent weather approximately 800 mi east of Bermuda on the 13th.

The midnight observations only had one 40-kt wind report, and there were no reports within 450 mi of the center. At 1200 on the 14th, the 958-mb LOW was at 52°N, 25°W. The AMERICAN LEGEND and NORBROTT were both pounded by 55-kt winds. The LUISE LEONHARDT, 500 mi due south, near 48°N, 24°W, was mauled by 60-kt winds and 33-ft seas. To the southwest of the center, the LEONID KRASIN was still involved with 55-kt winds and 36-ft seas. Between these two, the AMERICAN LEGEND found 50-kt gales. Many ships were reporting 35- to 45-kt gales all around the storm.

During the night, the winds reported were not as high--50 kt--but the seas and swells increased. Ocean Station Vessel "K" was tossed by 52-ft seas, the LE BASQUE by 46-ft seas, and the FORT CREVE COEUR by 33-ft swells.

Later in the day, at 1200 on the 15th, the reports picked up again. The LE BASQUE was still battling 50-kt winds. The ATLANTIC CHAMPAGNE found the 60-kt isotach, combined with the 39-ft isoline. Two newcomers to the high wind and sea fracas were the FRANKFURT and the NOVELIST, which weighed in at 55 kt. The storm passed over Ireland and England on the 16th and was losing some of its muscle. Gale winds were still plentiful off the Portuguese, French, and Irish coasts. Once on the downhill path, though, it rapidly became a has-been.

While the previous storm was delivering its last punches to shipping in the northeast Atlantic, this one was just forming. There were three large LOWs and two large HIGHs already churning the North Atlantic, and there hardly seemed room and energy for another. One of the other LOWs was located over Cape Chidley, with a front that curved to near Cape Hatteras. As usual, a 1010-mb wave formed on the front near 35°N, 70°W. It moved northeastward and, within 12 hr, was producing gale-force winds.

By 1200 on the 16th, it was near 44°N, 46°W. The CRYOS, south of Newfoundland, reported 60-kt winds, and the SHEAF CREST, southwest of the LOW center, near 39.5°N, 51°W, was battered by 50-kt winds, seas over 33 ft, and swells of 20 ft. The LENINSKIE GORY, at frontal passage, had 50-kt gales and 25-ft seas and swells.

The storm was now moving northward and, on the 17th, absorbed the remains of the LOW that was over Cape Chidley. Although the gradient was very tight, 50-kt winds were the maximum reported, and the honor went to ATLANTIC CAUSEWAY. On the 18th, the storm battered the southeast coast of Greenland, which spelled its demise on the rugged coast and ice-covered interior.

The origin of this storm was over Texas, late on the 14th. It moved eastward across the southern Gulf States. As it approached Cape Hatteras early on the 17th, it deepened rapidly to 990 mb. The USCGC TANEY, at 37.7°N, 72.5°W, measured a blasting 70-kt wind at 0900. Three hours later, the BOSTON, at 36.7°N, 71.6°W, estimated 63-kt winds. On the other side of the LOW, near 37°N, 67°W, the EXPORT PATRIOT battled 50-kt winds. At 0000 on the 18th, the 960-mb LOW was at 41°N, 65.5°W. The DEFIANCE, not far away at 40.2°N, 63.4°W, fought 75-kt winds and 41-ft seas.

As the LOW moved northeastward, it started to weaken, and, after the 18th, only gale-force winds were reported. A secondary LOW developed in the southern part of the trough, near 36°N. On the 21st,

the LOW passed over Iceland and northeastward over the Norwegian Sea on the 22d.

This storm goes back to the 17th and 18th, where it generated out of a generally diffuse weather pattern over the Great Plains. A dumbbell-shaped double high-pressure system had to move before the LOW could follow. By the 19th, the main portion of the HIGH had moved eastward, and the 989-mb LOW started its move toward the northeast. Early on the 20th, while the LOW was still over Ohio, gale-force winds were blowing off the East Coast. Off Cape Hatteras, a ship reported 45-kt winds just ahead of the front. Gale winds now extended north to Nova Scotia.

At 0000 on the 21st, the 984-mb LOW was near Prince Edward Island. The SIR HUMPHREY GILBERT, at 45°N, 58°W, was ravaged by 70-kt hurricane-force winds. The HAHNENTOR, further south, was washed by rainshowers driven by 45-kt gales. Neither reported sea conditions. Later on the 21st, a LOW developed south of the main center, and the CRYOS was hammered by 60-kt winds near 46.5°N, 57°W. The drilling rig VGBZ had 50-kt winds, as did the GOIB at 40°N, 60°W. Twenty-five foot waves were the highest reported. The winds were still roaring at 0000 on the 22d, when the CRYOS came in with devastating winds of 90 kt, near 46°N, 57.5°W. Further south, the HAHNENTOR, at 39.5°N, 55.5°W, almost matched that with an 80-kt report. The double center was still present, but, by 1200 on the 22d, the main center had again taken over the center ring at 984 mb. With this relaxation of the gradient, the CRYOS reported a paltry 40-kt gale. The LOW moved northward across Ocean Station Vessel "B," headed into the Labrador Sea and self-destruction.

Casualties--This was not a particularly good month on the Atlantic or in the Mediterranean Sea. The 963-ton Liberian FRANCINA caught fire in rough seas, was abandoned, and drifted aground near Cala Morell, Spain, on the 3d. The British trawler GAUL disappeared (last position 72.2°N, 24.8°E) and is missing during reportedly heavy weather in the area. The Danish 1,400-ton TUDOR PRINCE grounded on rocks while entering Valletta Harbor (Malta) during heavy weather on the 17th. The 10,006-ton Greek freighter AMETHYST was forced aground by rough weather off the mouth of the Douro River, Portugal, while waiting to enter the harbor. The KEYTRADER, 11,476 tons, was refloated in the Mississippi River and towed to a safe berth (Smooth Log, January 1974). The 20,500-ton DOCTOR LYKES regrounded in the southwest pass of the Mississippi River and was fogbound on the 7th. On the 17th, a LOW was located over Tunisia, and land station measurements did not indicate what was going on over the Tyrrhenian Sea off the Italian west coast. The 497-ton Italian-registered OMEGA sank in the stormy sea after hitting a rock. Seven crewmen were lost. The captain swam for 12 hr before reaching Sardinia's coast. (HURRAH!) The ELWOOD MEAD was freed from the reef in the English Channel after running aground on Christmas Day. She weathered some severe gales while stuck fast. The Liberian bulk carrier KONKAR RESOLUTE (25,139 tons) and the 13,737-ton tanker SOPHIA TRANSOCEANIC collided in dense fog off the Hook of Holland. The Cypriot 2,013-ton SANTA EIRINI became disabled with machinery trouble in heavy weather at 36.3°N, 20°E, on the 19th. The vessel was towed to port. The 2,428-ton Greek FAY II ran aground near Benghazi on the 24th in heavy weather. She was abandoned by the crew.

Smooth Log, North Pacific Weather

January and February 1974

SMOOTH LOG, JANUARY 1974--The number of cyclones this month was above normal, and the paths their centers traced were confused. The best that can be said of their comparison with climatology is that the general direction of travel was from west to east. Many did not hold to that rule, either, as they curved northward, northwest, and circled. Also, the concentration of tracks was much further south, especially in midocean.

A look at the 30-day anomaly sea-level pressure chart in comparison with the climatic mean would immediately indicate that the cyclone tracks would not be normal. Since weather is a global function and continuous, one could not expect that the North Pacific would be normal when the North Atlantic was so abnormal. The 1000.4-mb Aleutian Low is normally Low was 992 mb and centered near 44°N, 168°E. The high-pressure ridge extending seaward from both coasts was near normal, but the High over central Asia was about 8 mb above normal.

There were two major negative anomaly centers--a minus 12 mb near 40°N, 170°E, and a minus 10 mb near 38°N, 163°W. There were three positive anomaly centers that directly affected the weather of the North Pacific. They were a plus 4 mb in the Gulf of Alaska near 50°N, 145°W, a plus 12 mb over eastern Alaska, and a plus 19 mb north of the Kamchatka Peninsula.

There was one tropical cyclone this month in the western North Pacific--tropical storm Wanda. As last year, the first tropical cyclone started with a "W," with 1973 producing exactly the same number of cyclones as the list of names.

This LOW formed on the back side of another LOW on the 1st, near 32°N, 176°W. Under the influence of the upper-air trough, it raced eastward. On the 2d, the ELLEN BAKKE and FEDERAL NAGARA, southwest of the center, found 40-kt gales. By midday, the LOW had turned northward, and, at 0600 on the 3d, was near 41.5°N, 164.5°W. The ZIM NEW YORK was near 40.4°N, 158.4°W, at that time, and was mauled by 85-kt winds and 26-ft seas. At 0000 on the 4th, the 992-mb LOW was near 48°N, 165°W. The HOZAN MARU, at 52°N, 160.5°W, was hit by 45-kt southeasterly winds, with 23-ft seas and 28-ft swells. By 1200, the LOW had been absorbed into the circulation of a LOW centered over the Bering Sea.

The pressure pattern over the North Pacific during this week of the month was very diffuse, with many small and weak circulation systems. A new 1002-mb cyclonic circulation developed on the 4th and consolidated some of the confusion. The wave moved rapidly east-northeastward with light winds. As it deepened and the radius of circulation increased, so did the winds. By 1200 on the 5th, there were three reports of 40-kt gales west and south of the center. They were from the DAIAN MARU, WYOMING, and the JFZG. At 1800, the GRAND HOLLY reported a roaring 60-kt wind, east of the LOW at 34°N, 165°W. Six hours later, there were gale-force or greater reports in all directions from the center. The DAIAN MARU was now being buffeted by 50-kt winds with 33-ft seas and swells. The ANDES MARU, NORWAY MARU, and the WINDFORD all found 45-kt gales in various quadrants around the storm, with seas averaging 25 ft.

At 1200 on the 6th, the ANDES MARU, at 37°N, 172°W, about 160 mi due west of center (37°N, 169°W), fought 50-kt winds, as did the WYOMING, which also reported 36-ft seas. At 0000 on the 7th, the KAKO MARU, near 31°N, 167°W, was headed into 60-kt winds, 26-ft seas, and 30-ft swells. The USNS FURMAN, due west at 31°N, 173°W, fought 50-kt winds, 20-ft seas, and 36-ft swells. The JOHAN U. was not to be outdone, when she reported 50-kt winds, 33-ft seas, and 39-ft swells at 1200. Waves up to 18 ft high crashed against Oahu's north shore. On the 6th and 7th, there were at least four other ships that reported winds of 60 kt or higher and/or waves over 30 ft. Some reported more than one observation. They were the BRYNJE (60 kt and 32 ft), GRAND HOLLY (60 kt and 32 ft), SEALAND GALLOWAY (49 ft), and the WORLD PELAGIC (65 kt and 42 ft).

The 976-mb LOW turned northward on the 8th and then northwestward on the 9th. Cyclonic circulations were forming and moving around the southern periphery of the LOW. This generally weakened the gradient, and fewer high winds were reported.

One of these was to become a fairly strong storm itself. The LOW moved over the Aleutian Islands and entered the Bering Sea, where it disintegrated. Meanwhile, back on the 7th, the new LOW formed at the point of occlusion of a frontal system and moved out of the circulation of another major LOW. It tracked eastward until, on the 9th, it was near 33°N, 161°W, and producing 40-kt winds. On the 10th, the MOBIL ACME encountered 50-kt winds, and the WORLD PELAGIC, 55-kt winds and 30-ft swells. On the 11th, the storm reached its lowest pressure of 970 mb, and the WORLD PELAGIC, near 44.2°N, 145.5°W, continued to be ravaged by 60-kt winds and 32-ft swells. It, too, turned northward and then westward, to be replaced by another system on the 12th.

At 0851 January 10, a 7.5-magnitude earthquake occurred near 14°S, 167°E. This was in the New Hebrides Islands in the South Pacific Ocean, about 1,400 mi northeast of Brisbane, Australia. It was the second major quake in the area in 2 weeks. No reports of tsunamis or seismic waves were found.

On the 12th, there were two major cyclonic circulations, plus tropical storm Wanda, over the North Pacific. South of the col area, between the two extratropical storms, this LOW was born, at the low pressure of 985 mb.

It almost immediately took over the circulation of the eastern cyclone. At 0000 on the 13th, the 972-mb LOW was at 40°N, 156°W, and the KBAJ reported 45-kt gales southwest of the center. In the next 24 hr, the LOW made a loop in the area of 40°N, 155°W. The RHETORIC was south of the center and was hit by 50-kt winds. There were also reports of seas up to 20 ft and one report of swells up to 33 ft. The MONT-IRON, at 0600 on the 14th, near 33.3°N, 153.9°W, measured 60-kt winds and 30-ft waves.

The strongest winds developed by this storm occurred on the 15th. At 0000, the VANESSA, at 40°N, 139°W, and the CHEVRON CALIFORNIA, far to the southwest at 27°N, 146°W, had roaring 55-kt winds. Ocean Station Vessel "N" was rocked by 50-kt winds and washed down by heavy rain as the front passed. At 0600, the HAWAIIAN CITIZEN bucked 65-kt winds, and, at 1200, they were still 60 kt, 180 to 240 mi south of the LOW. Winds along the West Coast were fairly strong. NNCR reported 55-kt winds at the mouth of the Columbia River. To the south, off Cape Mendocino, a ship reported 40-kt gales, and there were two reports off Vancouver Island. Heavy rains were falling all along the West Coast, and flood warnings were posted in California and Oregon.

Other LOWs were forming on the edge of this LOW. A small LOW persisted over the Strait of Juan de Fuca for several days, and, on the 15th, another formed in the Gulf of Alaska. On the 16th, the original LOW was approaching the coast of Washington State. NNCR reported 55- to 40-kt winds and storm warnings for 60 kt were posted along the northern part of the U.S. coast. Gale winds stretched from the coast halfway to Hawaii. The LOW rapidly weakened as it approached land, and, by late on the 16th, the major circulation was the LOW in the Gulf of Alaska, which had remained quasi-stationary.

As the previous LOW moved eastward, a LOW which had moved eastward to 170°E turned northward and then westward, leaving a large area of weak pressure gradient in midocean. A ridge of high pressure was pushing down from the north and spreading westward. This helped develop a circulation, and, at 1200 on the 15th, a 997-mb closed LOW was analyzed near 35°N, 175°W. It quickly intensified and, at 0000 on the 16th, the DELWIND was suddenly fighting 40-kt gales. By 0000 on the 17th, the 976-mb LOW was at 37°N, 157.5°W, and the JGIR, about 400 mi to the southwest, found 50-kt winds.

The LOW was racing for the U.S. west coast. The REINHART LORENZ RUSS was blown by 45-kt gales. Many other ships had 35- to 40-kt gales, south and southwest of the center. As the LOW approached the coastline on the 18th, it turned and paralleled the coast, thus avoiding oblivion over the coastal mountains. At 1800, the GALVESTON found 55-kt storm winds at 53.2°N, 135.3°W. To the south along the Oregon coast, the SANTA MARIA was hit by the 50-kt storm. At 0000 on the 19th, its pressure was 966 mb, and, a few hours later, it had absorbed the stationary LOW that had waited in the Gulf of Alaska. At 1200, the PHILIPPINE MAIL, at 54°N, 154°W, was tossed by 55-kt winds and 18-ft seas and swells. The GALVESTON probably wished she were

back on the Gulf Coast as she was hit by 45-kt gales, snow, and 20-ft swells. This LOW now stalled in the Gulf of Alaska and was dissipating rapidly, finally disappearing on the 20th.

These storms caused millions of dollars damage in the five Pacific Northwest States. The death toll stood at 14. Mudslides, washout, and flooding took lives and closed major highways and railroad lines.

A large, weak, flat LOW was over the Sea of Okhotsk on the 16th. At 1200, a 995-mb center formed just north of Hokkaido. It tracked eastward until the 18th, when it stalled over the Kuroshio Current and deepened. The circulation widened considerably, occupying the western half of the ocean, and subsidiary LOWs were forming to the south and moving around the eastern side. The LOTUS found 40-kt winds very near the center. On the 19th, the ARCTIC TOKYO measured 48-kt winds north of the center, and the MARGARET CORD battled 45-kt gales as far away as just off Tokyo Bay.

On the 20th and 21st, the strongest wind band was well south of the center (mean of 40°N), between 25° and 30°N. The LONGVIEW VICTORY, 26.2°N, 161°E, found 55-kt storm winds with 38-ft swells, and the TRANSCOLORADO, 26°N, 176°W, reported 50-kt twice, with seas up to 25 ft. Gale-force winds were blowing over a wide area south of the 971-mb center. The GEIKO MARU, near 32°N, 163°E, also had 50-kt winds. On the 22d, there were three distinct centers, with their circulation covering from the Bering Strait to below 25°N and the Gulf of Alaska to Kamchatka Peninsula. The system was now in the degenerating stage, and, on the 23d, the parent LOW no longer was a circulation center.

This was one of the few storms that tracked across the Pacific from shore to shore. The LOW formed near Tokyo on the 21st. By 1200 on the 22d, it was near 36°N, 150°E, at 978-mb pressure. The BEREZNIKI, 300 mi to the south, reported 50-kt winds. At 0000 on the 23d, the LOW had two centers, but this did not slacken the wind speed. Two ships within a few miles of each other both were battered by 60-kt winds. They were the SACRAMENTO MARU and the TOYOTA MARU No. 2. They reported 8- to 12-ft seas and 20- to 26-ft swells. Twelve hours later, the JGIR had 45-kt winds. The 60-kt wind band was still present, even though no ship reported that high a speed, as, at 0000 on the 24th, the LJUBIJA was unlucky enough to find it.

The LOW was moving northeastward and competing with a large LOW to the west for its area of influence. At 0600 on the 26th, the LOW crossed the Aleutian Islands. It was now very weak and part of a trough out of the western LOW. On the 27th, it moved across the Gulf of Alaska and onto the continent, where it could be traced to the Labrador Sea on the 31st.

This storm formed on the same day as the last one, except further west over Manchuria. It started at 1017 mb and was 992 mb by the time it crossed Japan, although still not much of a storm. At 1200 on the 24th, it was at 45°N, 151°E, where it stalled for 24 hr. During that time, the pressure decreased to 972 mb and the circulation occupied the western half of the ocean. At 0000 on the 25th, there was a report of 70-kt hurricane-force winds and two 50-kt storm wind reports. Because the isobars were so closely packed on the analysis, the identity of the 70-kt and one 50-kt report could not be determined. They were both north-northeast of the LOW along the Kuril Islands. Southeast of the center, the PHILIPPINE MAIL was battered by 65-kt hurricane-force winds, near 37.7°N, 145.2°E, at 0600. The seas were 25 ft, and the swells were 20 ft. The MORI MARU reported 50-kt winds 300 mi south of the center near 40°N, 150°E. Gale-force winds were in all quadrants. At 1200, Ostrov Paramushir measured 60-kt winds from the northeast. On the 26th, two ships reported 45-kt winds east of Hokkaido. One was being battered by 21-ft seas and 41-ft swells. At 0000, the WOERMANN SASSANDRA was near 41.4°N, 146.2°E, and received a 55-kt battering.

The LOW drifted eastward and appeared to use up much of its energy. On the 28th, it started to move northward with a pressure of only 990 mb. The gradient had weakened to such an extent that not even gale-force winds were reported. Also, by this time, other LOWs had formed and were absorbing the system. The gradient to the north of this and another LOW, over the Bering Sea, were still tight as they pressed against a 1057-mb HIGH west of the Bering Strait. A Japanese ship reported violent 60-kt winds near 53.5°N, 179.5°E. The storm was now moving westward across the Kuril Islands and again in the Sea of Okhotsk, where it was lost on the 30th.

For the third year in the past four, the western North Pacific's first tropical cyclone formed in January. This year it was Wanda. Wanda was first detected on the 10th, some 350 mi east of Yap Island. She was already a tropical storm, generating 50-kt winds near her center. At 0300, the CLIFFORD MAERSK was at 13.2°N, 130.7°E. She was fighting 46-kt gales, with heavy rain and 23-ft seas, along with 32-ft swells. Gales extended out to nearly 200 mi in all directions, and she was in the process of recurving. By the 11th, Wanda was heading east-northeastward, away from the Philippines. She was also starting to weaken. Winds fell below tropical storm strength by the 12th. The following day, the weak depression moved to the north of Saipan.

Casualties--The first casualty for the month was a 30-ft cabin cruiser which apparently dragged its anchor in winds up to 48 kt and broke up in heavy surf. A 68-ft fishing vessel capsized off the Golden Gate Bridge on the 17th, in turbulent seas. The crew escaped. Massive icefloes from the Sea of Okhotsk trapped 11 ships off the north shore of Hokkaido on the 13th. Most escaped through cracks and leads in the 2- to 6-in-thick iceflows.

The 75-ft shrimp trawler JOHN AND OLAF was located aground near Jute Bay, Alaska. There was no sign of the four crewmembers. The trawler had sent a May Day message on the 16th, saying the vessel was heavily iced and in danger of sinking. See page 170 of the May 1974 issue for more information. The 548-ton Korean HAE UN sank like a stone, with a cargo of stones, off Hakata, Japan, on the 14th, during high winds. Two crewmen were rescued, 14 bodies were recovered, and 4 are missing.

The CUNARD CHAMPION, from New Orleans, was

due Chiba and Kawasaki on the 23d, with heavy weather damage. The 16,005-ton Liberian bulk carrier BONANZA was at Kawasaki on the 30th with heavy weather damage. The American tanker HESSBUNKER (14,126 tons) arrived at Kobe on February 1 from St. Croix with number 7 tank cracked due to heavy weather in the Pacific Ocean.

SMOOTH LOG, FEBRUARY 1974--The monthly cyclone track chart was near normal. The number of cyclones may have been slightly below normal, but the difference was a traffic jam off the southeast coast of the Kamchatka Peninsula. The primary track extended from central Japan to the Gulf of Alaska. There were a few mavericks, but they were generally not significant. An additional discrepancy from normal was the lack of storm centers south of Portland, Oreg.

The climatic mean sea-level pressure chart indicated a 1000.3-mb Low about 51°N, 172°E; a 1020.8-mb High near 31°N, 138°W; a ridge of high pressure extending out of the Siberian High across Okinawa, along approximately 25°N to near the Date Line; and a series of small Highs over the United States and Canada. On this month's mean-pressure chart, the Highs were normally located, but the one off the U.S. west coast was about 4 mb higher in pressure at 1025 mb, as was the pressure over the western United States at 1023 mb. The Aleutian Low was split into two centers, one southeast of the Kamchatka Peninsula near 48°N, 160°E, at 1001 mb, and the other in the Gulf of Alaska near 57°N, 148°W, at 995 mb.

The anomalies, of course, were associated with the departures from the climatological mean, both in location and value. The largest was a negative 16 mb in the northern part of the Gulf of Alaska. The Low center that was just off the Kamchatka Peninsula did not produce a large anomaly; in fact, its displacement produced a positive anomaly ridge out of Siberia, south into the Bering Sea. The central eastern half of the ocean--20°N to 40°N and 180° into the United States--was dominated by a large positive anomaly with three centers, two of 5 mb and the central one of 6 mb.

There were no tropical cyclones in the North Pacific this month. None would be expected in the east, but there is an average of one tropical storm every 4 yr in the west, and about one of these will reach typhoon intensity every 15 yr.

During the first 10 days of the month, a large high-pressure area dominated the eastern North Pacific off the U.S. west coast. Only two relatively weak LOW centers penetrated the Gulf of Alaska, and one of these on the last day. The storms during the first part of the month were fewer than usual and weak except for the monster, which dominated the scene.

This storm probably had its birth in January, as, at 0000 on the 1st, it was a 1012-mb wave near 31.5°N, 148.5°E. It moved eastward and then northeastward until, at 0000 on the 3d, it was at 44°N, 178°E, at 984 mb. The BEISHU MARU, near 40.9°N, 179.5°E, measured 52-kt winds. The AIDA, 12 hr later, estimated 50-kt winds and 23-ft seas and swells at 43.7°N, 151.6°E. On the 4th, the MARITIME ACE measured 46-kt winds west of the center.

After passing across the Aleutians into the Bering Sea, the storm weakened and, on the 7th, was absorbed into the circulation of a deeper system that was following.

This LOW was not a viscous one, but deserves mentioning. It came alive on the 6th. A front was south and east of Japan, oriented more or less east-west. Small waves were forming and dissipating, but this one developed further east and continued strengthening. At 1200, the SURUGA MARU caught 40-kt winds just a few miles south of the 999-mb center. Twelve hours later, the EISHO MARU was treated to heavy rain and 50-kt winds, as the front passed her position near 34°N, 159°E. Winds of 35- to 40-kt were now being reported 400 to 500 mi to the east and west of the center.

The LOW had traveled to 42.5°N, 176.5°W, by midnight on the 7th. The RONA and another ship reported 50-kt northerly gales west of the center. The MANDARIN VENTURE, just east of the front, south of the center, also found 50-kt gales. The SANTA CATALINA MARU, at 39°N, 172°E, which was about 400 mi behind the cold front, reported only 30-kt northerly winds, with 8-ft seas, but the swells were 36 ft from 240°. On the 8th, the PAN ASIA measured 50-kt winds southwest of the center near 39.7°N, 175.9°E. The visibility was reduced to 600 ft.

The storm now took a more northeasterly than northerly course, and, by 0000 on the 9th, overtook and absorbed another LOW which was over the Aleutians. The cyclonic circulation was now larger, but the winds were not as strong. The LOW tracked up the island chain and was over the Kenai Peninsula on the 10th. Gale winds were widespread over the Gulf of Alaska, but the highest plotted were two 40-kt reports. The LOW idled in the northern Gulf until the 15th, when it again started moving eastward under upper-air influences.

Monster of the Month--This most severe storm of the month developed in a low-pressure trough that deepened as it moved across Japan on the 7th. The LOW deepened very rapidly to 972 mb, near 39°N, 147°E, by 1200 on the 8th. The SITKA MARU, northeast of the center, ran into heavy rain and storm winds of 60 kt. South of Shikoku, the CATHAY had only 40-kt winds, but waves from three directions. An unidentifiable ship reported 45 kt, south of Tokyo. The MONT-IRON measured 55-kt winds at 36.3°N, 150.5°E, with 32-ft seas. Other ships were measuring or reporting 45- to 50-kt winds. The MARCONA TRADER was riding out 41-ft swells in the vicinity of 36°N, 141°E.

Twelve hours later, the winds were really roaring. Gale-force and higher winds extended out to 600 mi to the south and east, and over 400 mi to the northeast. The BRIS and SANDAR, both south of the LOW, were battered by 60-kt winds. The HONSHU MARU, about 300 mi to the northeast, had heavy snow and 50-kt winds. The KIKUTAMA MARU, about 200 mi south of the center, had 50-kt winds and 31-ft seas. The PRESIDENT FILLMORE was bashed by 64-kt winds.

At 1200 on the 9th, the LOW had a pressure of 954 mb, near 42°N, 153°E. The HONGKONG MAIL was at 41.5°N, 147.3°E, and felt the wrath of the sea, with 70-kt winds. The SHOGEN MARU, at 45°N, 163.5°E, found another 60-kt band of winds, and the KIKUTAMA MARU was still battling 50-kt

winds and 30-ft seas on her easterly course. The LOW was still deepening and spreading on the 10th, with its circulation pattern covering the area from Korea to 180°. The MARITIME ACE measured blasting 64-kt winds at 50°N, 156.9°E, at 0600. Earlier, she had reported 50-kt winds, 25-ft seas, and 28-ft swells, about 140 mi east of Ostrov Paramushir, which was reporting 70-kt winds. South of the 952-mb center, the SHINKYO MARU was being pushed along by 55-kt winds, driving 38-ft seas and 25-ft swells. At 1200 on the 10th, the LOW was turning northward, with Ostrov Paramushir still suffering from a 65-kt blizzard.

On the 11th, the LOW was moving slowly northward along the Kuril Islands. The pressure was slowly rising, so the gradient relaxed a little. Gale-force winds were plotted as far east as 170°W and south to 30°N. The MOSKALVO, near Ostrov Urup, was blown by 50-kt winds. Minor LOWs were now forming on the periphery of the circulation, as the major center wandered in the area off the southeast coast of Kamchatka. Ostrov Simushir reported 60-kt winds. The report by the PENEZHINA, near 55°N, 154°E, in the Sea of Okhotsk, at 1200 on the 12th, was decoded to read a roaring 70 kt. Twelve hours later, the island of Simushir measured 50-kt winds. The LOW continued filling and, at 0000 on the 14th, was 982-mb.

The satellite LOWs continued to form and move around the edge. At 0000 on the 13th, one of the stronger ones formed near northern Honshu. Twenty-four hours later, it was at 40.5°N, 163°E. Gale-force winds were blowing around its southern quadrant. Forty-five-knot gales were reported by the KUROBE MARU and the NEW JERSEY MARU, south and southwest of the center. Twenty-four hours later, both were still being hit by 40- and 45-kt gales, as they approximately paralleled the storm's track. The PRESIDENT MADISON measured 50-kt winds at 1800 on the 14th, near 32.8°N, 161.5°E.

This was now becoming the dominant storm, as the old LOW filled. The pressure had dropped to 970 mb. On the 16th, this had become the main circulation across the Northern Pacific. At 0000, it was located at 47°N, 178°W, and moving very slowly toward the northeast. The AXEL U. had freezing 55-kt storm winds at 50.9°N, 178.8°W, at 0600. Although the winds in this storm did not get exceptionally high, they were widespread. The storm continued east-northeastward, with isolated maximum winds of 35 kt, into the Gulf of Alaska, where it filled on the 20th.

This was the second most powerful storm over the North Pacific this month. It began late on the 15th, northeast of Tokyo. It developed slowly as it moved eastward. The first gale-force wind was 35 kt, reported at 0000 on the 17th by the REINHART LORENZ RUSS, near 34.5°N, 160°E, about 100 mi south of the 1006-mb center.

Near midocean on the 18th, the pressure had dropped to 985 mb. On the 19th, the PRESIDENT GRANT was hit by 40-kt gales, near 38.5°N, 162°W, about 250 mi south of the center. The LOW was racing toward the Gulf of Alaska and the semipermanent LOW that had established itself there. This reinforced the already present LOW. At 1200 on the 20th, the ALASKAN MAIL (55°N, 149°W) and the SERGEY YESENIN (51.5°N, 160°W) both reported 45-kt gales. On that chart, a small LOW developed at the occlusion and raced toward the center, again increasing the gradient and circulation. A station on Queen Charlotte Island measured 60-kt winds. The ARCO PRUDHOE BAY, at 59°N, 151.7°W, found howling 55-kt winds. Winds of 35 to 45 kt were widespread. Ocean Station Vessel "P" measured 40-kt winds and 25-ft seas. Twelve hours later, she still had the same winds and seas, with added 30-ft swells. Kodiak, Alaska, suffered its highest wind of the month of 48 kt, with a maximum gust of 55 kt. The NEVADA STANDARD ran into 60-kt winds at 0300 on the 21st, at 53.1°N, 133.6°W, with 32-ft swells.

On the 22d, the LOW was filling and weakening, and, on the 23d, another LOW came in from the southwest to intensify the system again.

A frontal wave was the mother of this storm. It started south of Tokyo on the 17th. It moved mostly eastward, and, on the 18th, the CHICAGO MARU had 45-kt gales at 34°N, 157°E, just before the 992-mb LOW passed to the north. On the 19th, a ship radioed a 50-kt gale report, while 120 mi east of the center.

On the 20th at 0600, the ASIA BRIGHTNESS was engulfed with 65-kt winds and 39-ft swells at 43.2°N, 165°E. On the 21st, the center turned southeastward as it moved around the outskirts of the Alaskan Low. Late on the 22d, there was an almost explosive filling, and the very weak LOW raced around the edge of the LOW in the Gulf of Alaska. It moved ashore on the 24th.

There was evidence of a Tehuantepecer on the 25th and 26th. A cold front moved southward across the Gulf of Mexico on the 24th and 25th, as a cold HIGH pushed southward into Texas. The first report of 45 kt was at 1800 on the 25th, by the AMERICAN LYNX, at 14.8°N, 96.2°W. As she proceeded southeastward, paralleling the coast, the winds were directly out of the north, at 0000 on the 26th, near 13.9°N, 94.4°W. At 1200, the PRESIDENT PIERCE measured 60-kt winds and 18-ft seas out of the north, not far away, near 13.2°N, 95°W. Later in the day, at 1800 on the 26th and 0000 on the 27th, the EXPORT COMMERCE, in the vicinity of 10°N, 97°W, found 45-kt winds from the northeast, with seas of 25 ft on the first report and 16-ft seas with 20-ft swells on the second report.

A strong earthquake rocked the Aleutian Islands on the 5th. It registered 6.3 on the Richter scale, and its epicenter was about 70 mi east of Unalaska. On the 11th, the SUMMIT reported that the volcano on Akutan Island was in a state of eruption. Volcanic ash and debris were spewing several hundreds of feet into the air, and molten lava was flowing down the side. The volcano is located about 45 mi northwest of where the earthquake was recorded.

Casualties--The American CANADA BEAR (8,739 tons), for Tacoma, returned to Brisbane on the 7th with heavy weather damage. Five containers were lost overboard, and 12 sustained damage. A Republic of Korea Navy tugboat carrying 316 men capsized and sank in rough seas off South Korea's southern coast on the 22d. It was reported that 157 men were rescued.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

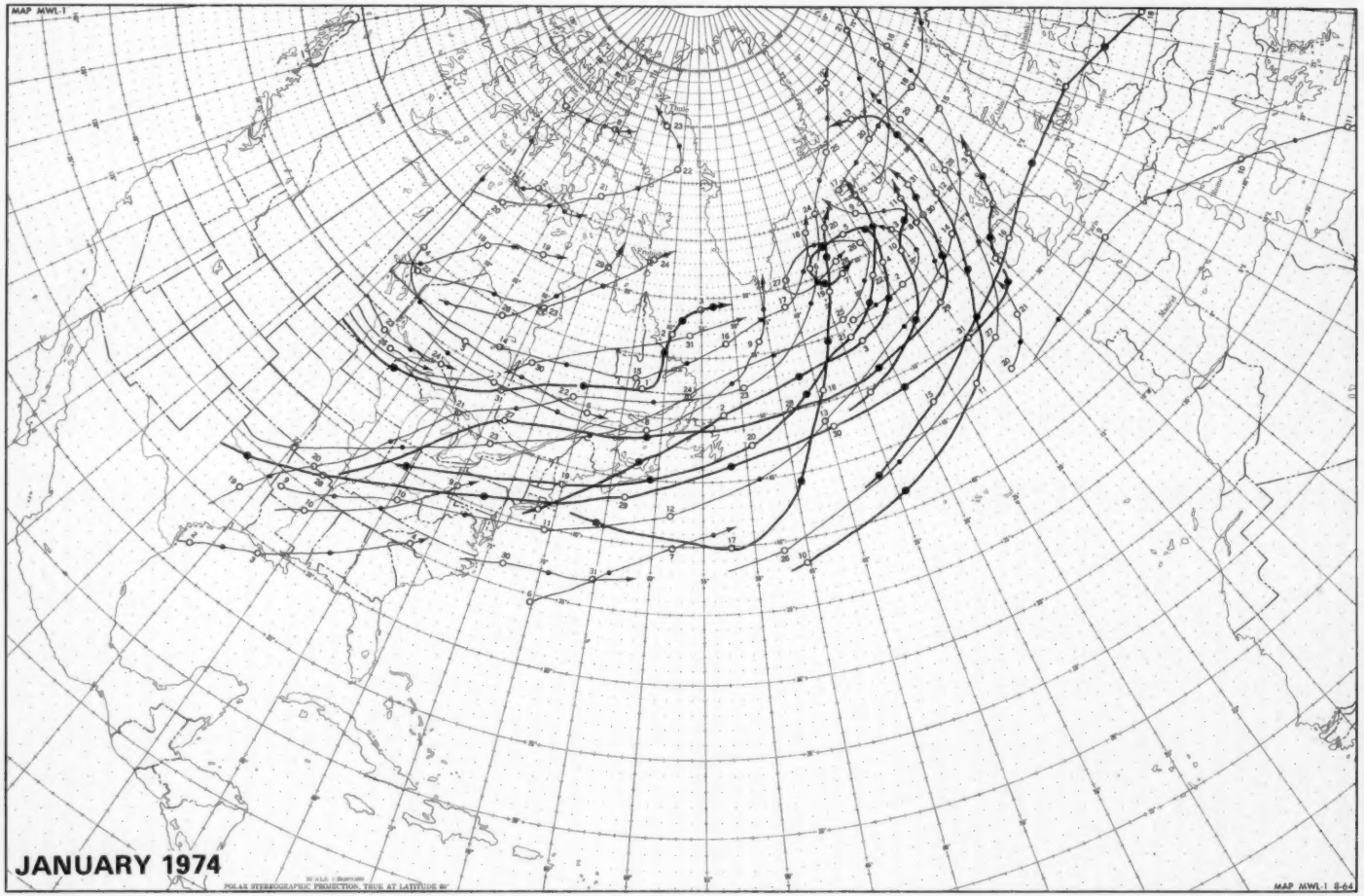

Figure 45. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

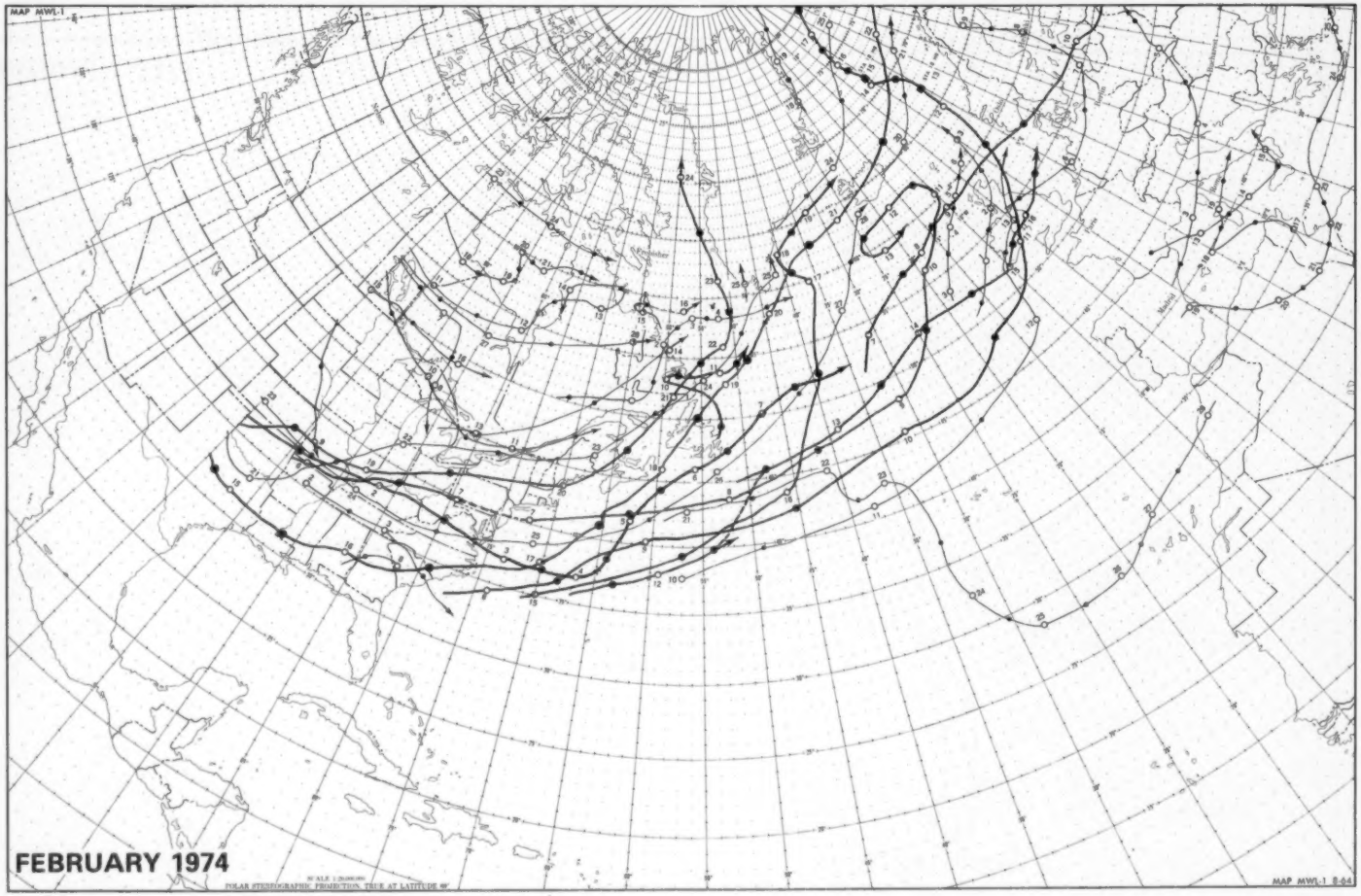

Figure 46. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

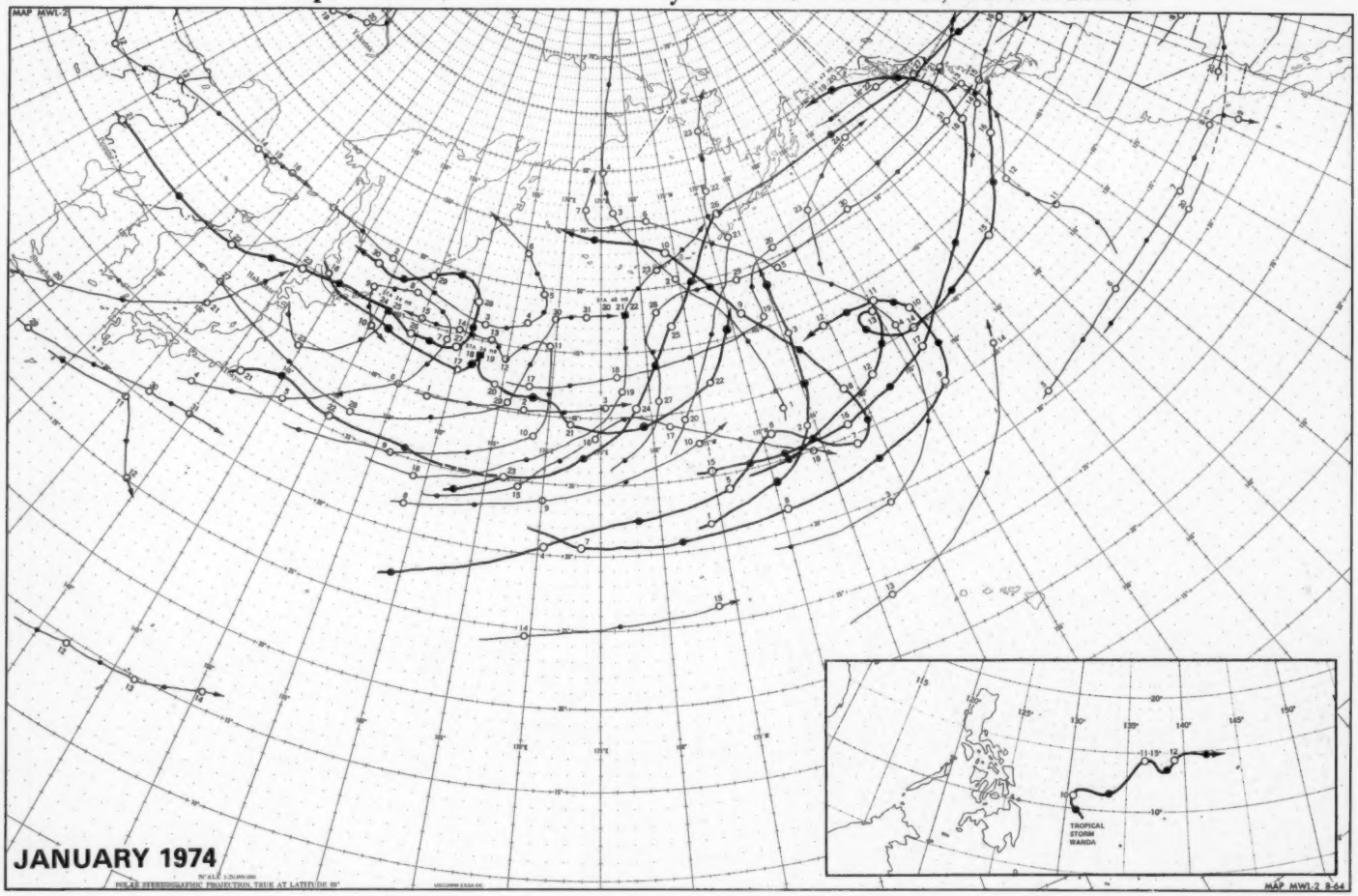

Figure 47. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

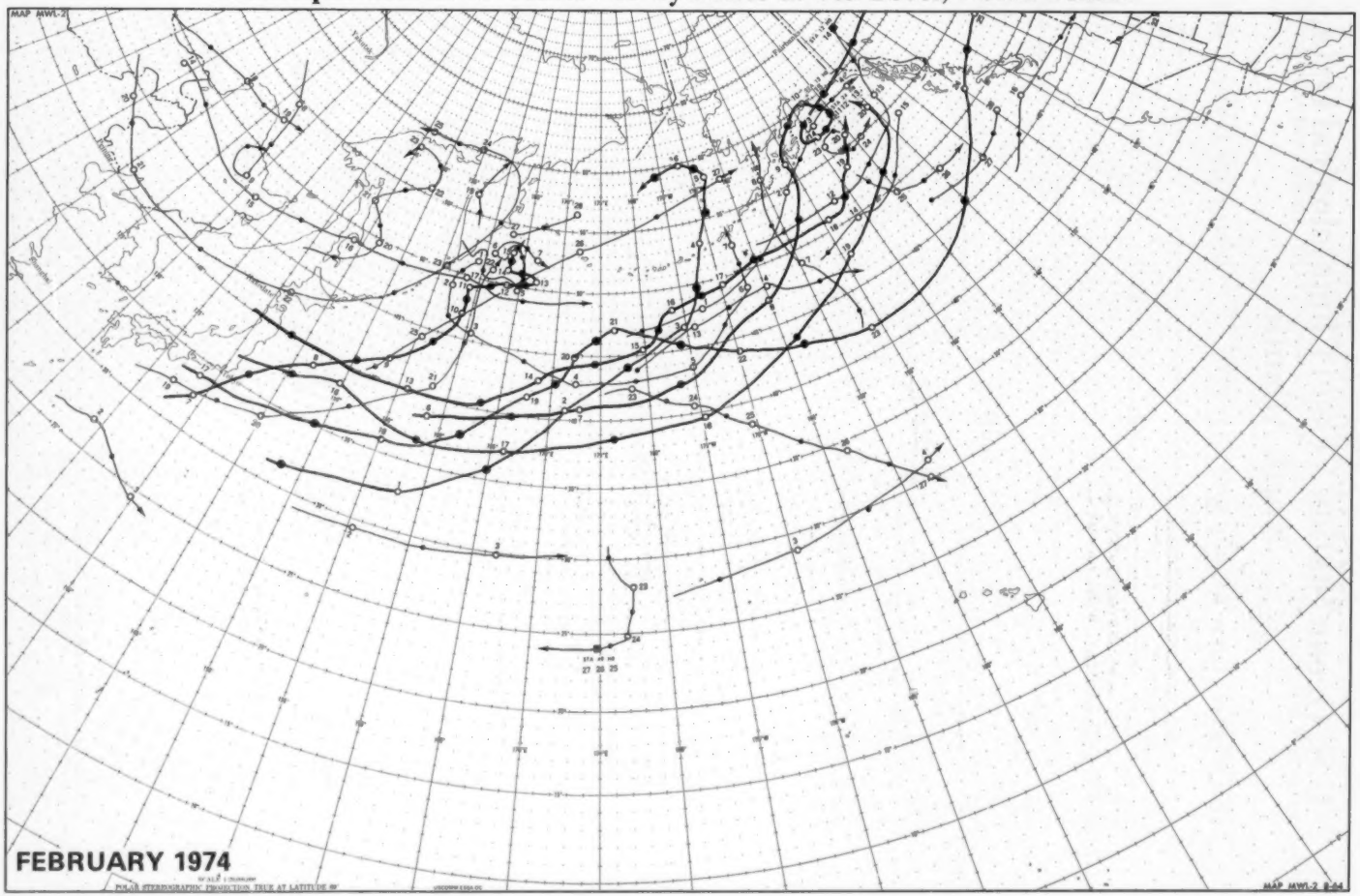

Figure 48. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 8
U.S. Ocean Station Vessel Climatological Data, North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W **January and February, 1974**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JAN	-11.3	09 00	- 3.2	9.1	01 09	-18.6	28 06	- 8.3	1.4	31 21	- .5	28 09	2.2	3.9	31 09	-13.3	09 00	- 5.4	1.0	01 03
FEB	-12.3	15 12	- 3.0	2.8	22 00	-18.5	04 06	- 8.3	2.1	08 21	- .5	21 15	2.8	4.3	21 03	-13.9	03 09	- 4.6	1.3	21 18

MEANS AND EXTREMES — PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) — DAYS WITH SPECIFIED WEATHER

MONTH	PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	TOTAL CLOUD 0-2	3-5	6-7	& & OBSC	LOW CLOUD 0-2	3-5	6-7	& & OBSC	RAIN OR DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JAN	934.5	16 15	992.4	1014.8	21 15	.4	16.0	42.2	41.4	4.1	29.9	46.9	29.0	31	29	31	0	3	19	5	0	27	49.0	244
FEB	971.8	02 03	997.8	1018.0	21 03	5.4	13.1	10.7	84.7	8.6	19.1	18.2	54.1	26	23	22	1	2	13	4	0	25	41.9	222

** VV=80-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

JAN — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	1.7	7.3	.4	.0	9.4	24.2
NE	.0	.5	1.2	2.5	.3	.0	4.5	23.8
E	.0	.3	1.1	3.2	1.3	.0	5.9	27.5
SE	.0	.4	.0	.1	.0	.0	1.4	11.9
S	.0	.0	.8	.0	.0	.0	.8	19.5
SW	.0	2.5	4.4	.0	.0	.0	6.9	11.9
W	.0	2.0	7.0	9.1	2.0	.4	21.5	22.9
NW	.0	.4	5.8	28.7	12.3	2.0	49.1	29.5
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	.4	6.1	23.8	51.8	16.4	2.5	100.0	25.8

NUMBER OF OBS 244 — MAX WIND DIR 310, SPEED 60, DA HR 27 1400 — VECTOR SPEED 18.9, MEAN DIR 314 (DIR IN DEGREES)

FEB — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.3	.8	2.3	1.1	.8	7.2	24.7
NE	.0	4.1	2.0	7.4	2.6	1.4	17.5	25.7
E	.3	.7	2.0	6.4	1.6	.3	11.5	25.0
SE	.3	.9	1.9	2.0	1.4	.6	7.2	23.5
S	.3	1.2	2.7	2.9	1.2	.0	8.2	20.9
SW	.9	2.9	4.1	1.8	3.7	.0	13.4	21.4
W	.9	1.0	2.9	8.2	.9	.0	17.9	21.3
NW	.3	3.6	5.2	4.8	1.0	.1	16.2	19.1
CALM	.9	.0	.0	.0	.0	.0	.9	.0
TOTAL	4.5	16.7	20.6	33.6	13.5	3.2	100.0	22.4

NUMBER OF OBS 222 — MAX WIND DIR 120, SPEED 60, DA HR 02 0100 — VECTOR SPEED 3.0, MEAN DIR 348 (DIR IN DEGREES)

Wave

JAN — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.3	2.3	3.7	4.1	.0	.0	.0	10.4
NE	.0	.0	1.0	1.7	2.0	.1	.0	.0	5.4
E	.0	.0	1.7	1.5	3.1	.3	.0	.0	6.7
SE	.0	.4	.5	.0	.1	.0	.0	.0	1.0
S	.0	.0	.0	.0	.0	.0	.0	.0	.0
SW	.0	.3	1.0	.1	.0	.0	.0	.0	1.4
W	.0	1.1	3.8	3.7	6.3	.0	.0	.0	14.9
NW	.4	.9	3.0	21.2	28.2	1.2	.0	.0	54.9
IND	.0	.0	4.1	.0	.0	.0	.0	.0	4.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.4	6.1	17.6	32.0	44.3	1.6	.0	.0	100.0

NUMBER OF OBS 244 — IND=INDETERMINATE

FEB — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.8	4.1	.8	1.7	.7	.5	.0	.0	8.5
NE	1.0	4.4	5.5	.8	.1	2.6	.0	.0	14.3
E	.0	1.4	3.1	4.1	.3	1.0	.0	.3	11.2
SE	.5	1.3	1.0	1.3	.9	.9	.0	.1	6.3
S	.5	1.3	.8	2.4	2.9	.7	.0	.0	8.7
SW	1.4	3.1	.1	1.7	2.1	3.1	.0	.0	11.4
W	.8	4.4	1.0	3.1	3.3	1.0	.0	.0	10.7
NW	2.4	5.0	2.9	4.3	1.4	1.0	.0	.0	17.0
IND	.0	.3	1.4	1.8	1.4	.0	.0	.0	5.0
CALM	.9	.0	.0	.0	.0	.0	.0	.0	.9
TOTAL	8.1	20.7	17.2	23.1	13.1	11.3	.0	.5	100.0

NUMBER OF OBS 221 — IND=INDETERMINATE

JAN — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	2.9	4.1	.4	.0	.0	.0	.0	7.0
6-7	.4	.4	4.1	18.0	6.1	.0	.0	.0	29.1
8-9	.0	.4	4.9	6.1	32.4	1.6	.0	.0	45.5
10-11	.0	.0	.4	7.4	5.3	.0	.0	.0	13.1
12-13	.0	.0	.0	.0	.4	.0	.0	.0	.4
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.8	4.1	.0	.0	.0	.0	.0	4.9
TOTAL	.4	4.1	17.6	31.9	44.3	1.6	.0	.0	100.0

NUMBER OF OBS 244 — MAX WAVE HEIGHT MGT 8.0, PER 9, DIR 070, TYPE SEA, DA HR 01 00 — IND=INDETERMINATE (DIR IN DEGREES)

FEB — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	8.1	20.4	8.6	7.2	1.8	.0	.0	.0	46.2
6-7	.0	4.1	7.2	10.4	6.6	3.9	.0	.0	34.4
8-9	.0	.0	.0	3.2	3.2	4.1	.0	.0	10.4
10-11	.0	.0	.0	.0	.0	1.4	.3	.0	1.4
12-13	.0	1.4	.0	.3	.0	.0	.0	.3	2.3
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.9	1.4	1.8	1.4	.0	.0	.0	5.4
TOTAL	8.1	26.7	17.2	23.1	13.1	11.3	.0	.5	100.0

NUMBER OF OBS 221 — MAX WAVE HEIGHT MGT 10.9, PER 12, DIR 110, TYPE SEA, DA HR 02 03 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 9
CLIMATOLOGICAL DATA

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — January and February, 1974

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JAN	2.1	13 21	14.3	23.0	27 12	- 3.7	14 09	10.0	18.4	27 09	12.4	•13 06	19.9	24.7	•21 21	>15.9	14 18	- 9.6	3.4	11 18
FEB	3.0	•09 15	10.2	19.8	22 18	- 5.7	10 12	4.9	17.4	23 00	9.0	13 00	17.8	23.9	18 00	>17.8	05 15	- 7.6	2.7	23 00

MONTH	PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	RAIN OR DRZL	SNOW	TSTM	VISBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JAN	1005.5	17 06	1020.1	1034.8	•14 15	7.1	17.9	38.1	42.9	21.7	30.7	25.5	22.2	19	19	2	1	0	5	1	0	18	19.7	212
FEB	971.9	17 12	1013.3	1029.7	28 00	10.4	19.3	23.0	47.4	29.9	19.7	25.4	29.1	14	14	2	2	2	8	2	0	8	19.3	135

** VV-90-93 AND/OR W=4 — COMP OB DAYS=COMPLETE OB DAYS

Wind

JAN — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	3.3	12.4	3.3	.0	.0	21.0	17.1
NE	.0	3.4	12.9	1.1	.0	.0	17.3	14.7
E	.0	2.0	2.8	1.4	.0	.0	6.0	15.9
SE	.0	.9	1.1	.9	.5	.0	3.4	19.9
S	.0	.0	2.2	2.8	1.3	.0	6.0	23.8
SW	.5	1.1	3.4	6.8	2.1	.5	16.4	25.4
W	.0	1.9	4.7	9.0	.7	.0	15.9	22.3
NW	.0	1.4	8.0	3.9	.1	.0	13.4	20.1
CALM	.4	.0	.0	.0	.0	.0	.5	.0
TOTAL	.9	13.7	45.9	34.0	4.7	.5	100.0	19.8

NUMBER OF OBS 212 — MAX WIND DIR 220, SPEED 50, DA HR 09 1800 — VECTOR SPEED 9.7, MEAN DIR 293 (DIR IN DEGREES)

FEB — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.7	9.0	1.5	1.1	.0	11.1	19.3
NE	1.5	1.5	4.3	.4	.0	.0	7.6	13.4
E	.0	.7	2.6	1.5	.0	.0	4.1	16.6
SE	.0	.0	.0	.7	.7	.0	1.5	34.0
S	.0	.0	.7	3.7	1.5	.7	6.5	30.5
SW	.0	3.7	9.1	1.1	3.4	.0	18.4	20.4
W	.0	2.8	6.9	3.8	2.6	1.5	19.4	24.2
NW	.0	2.4	9.8	11.3	12.4	.7	36.7	27.9
CALM	.7	.0	.0	.0	.0	.0	.7	.0
TOTAL	2.2	11.9	34.6	27.4	29.7	3.0	100.0	24.0

NUMBER OF OBS 135 — MAX WIND DIR 330, SPEED 60, DA HR 17 1300 — VECTOR SPEED 12.9, MEAN DIR 296 (DIR IN DEGREES)

Wave

JAN — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	1.5	5.8	9.7	3.1	.0	.0	.0	.0	19.9
NE	.0	6.8	5.2	.6	.0	.0	.0	.0	14.6
E	.0	1.2	1.2	.9	.0	.0	.0	.0	3.3
SE	.0	3.3	1.3	.5	.5	.0	.0	.0	5.8
S	.0	.6	4.9	1.7	1.9	.0	.0	.0	9.0
SW	.9	3.3	3.0	3.7	4.0	.0	.0	.0	14.9
W	.0	3.4	6.5	4.8	1.7	.0	.0	.0	16.2
NW	.1	1.1	7.4	2.3	.0	.0	.0	.0	11.1
IND	.0	1.4	3.3	.0	.0	.0	.0	.0	4.7
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.9	28.3	44.3	17.5	8.0	.0	.0	.0	100.0

NUMBER OF OBS 212 — IND=INDETERMINATE

FEB — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.7	1.5	3.7	2.4	1.7	.0	.0	.0	10.0
NE	.0	.0	3.9	.2	.0	.0	.0	.0	4.1
E	.0	.7	2.6	.0	.0	.0	.0	.0	3.3
SE	.0	.0	.0	.7	.7	.0	.0	.0	1.5
S	.0	1.5	2.2	2.6	3.3	.0	.0	.0	9.8
SW	2.2	3.9	1.7	.2	1.9	1.3	.0	.0	11.3
W	.0	4.8	9.4	1.5	2.0	2.2	.0	.0	19.5
NW	.9	4.8	5.0	10.0	13.3	4.4	.7	.0	39.1
IND	.0	3.0	.7	.0	.0	.7	.0	.0	4.4
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.4	20.0	29.2	17.8	23.0	8.9	.7	.0	100.0

NUMBER OF OBS 135 — IND=INDETERMINATE

JAN — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	1.9	18.9	18.9	2.3	.0	.0	.0	.0	42.0
6-7	.0	7.1	19.8	12.7	2.8	.0	.0	.0	42.3
8-9	.0	.9	2.4	1.4	5.2	.0	.0	.0	9.9
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	1.4	3.3	.0	.0	.0	.0	.0	4.7
TOTAL	1.9	28.3	44.3	17.5	8.0	.0	.0	.0	100.0

NUMBER OF OBS 212 — MAX WAVE HEIGHT: HGT 5.9, PER 8, DIR 240, TYPE SEA, DA HR 27 18 — IND=INDETERMINATE (DIR IN DEGREES)

FEB — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	3.0	14.1	3.9	.7	.0	.0	.0	.0	23.7
6-7	1.5	3.0	17.8	11.9	6.1	.0	.0	.0	42.2
8-9	.0	.0	.7	4.4	11.1	4.4	.7	.0	21.5
10-11	.0	.0	.0	.7	3.7	3.7	.0	.0	8.1
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	3.0	.7	.0	.0	.7	.0	.0	4.4
TOTAL	4.4	20.0	23.2	17.8	23.0	8.9	.7	.0	100.0

NUMBER OF OBS 135 — MAX WAVE HEIGHT: HGT 8.0, PER 9, DIR 320, TYPE SEA, DA HR 17 15 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 10
Selected Gale Observations, North Atlantic
January and February 1974

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		JAN.															
SS SEALAND ECONOMY	AMERICAN	2	45.8 N	17.4 W	06	23	M 46	5 NM	18	991.5	11.7	12.8	5	10			
SS APOINDIA	AMERICAN	3	41.7 N	43.8 W	18	29	55	10 NM	02	1006.4	7.3	17.8	5	10	29	9	18
MV BERTHA FISSER	PANAMANIAN	3	45.7 N	15.3 W	18	23	47	5 NM	82	990.0	14.0		XX	39			
SS MITRA	NORWEGIAN	3	43.1 N	44.5 W	12	29	52	5 NM	09	1013.0	5.0	17.0	6	16.5			
SS SEALAND ECONOMY	AMERICAN	3	41.3 N	30.0 W	18	26	M 41	5 NM	18	993.2	11.2	15.6	5	8	27	8	16.5
MV ACADIA FOREST	NORWEGIAN	4	39.1 N	34.7 W	12	29	M 50	2 NM	07	1003.3	11.0	15.0	11	32.5			
SS APOINDIA	AMERICAN	4	41.5 N	37.4 W	12	28	55	5 NM	51	1001.0	7.2	10.7	2	13	29	>12	19.5
MV BERTHA FISSER	PANAMANIAN	4	44.1 N	19.1 W	12	23	47	5 NM	81	989.0	12.0		XX	39			
SS LASH TURKIVE	AMERICAN	4	40.6 N	42.9 W	06	31	30	2 NM	26	1009.1	5.0	16.7	8	14.5	31	9	37.5
SS MITRA	NORWEGIAN	4	43.0 N	45.0 W	06	29	58	2 NM	87	1014.0	3.0	18.0	8	24.5	30	8	24.5
SS ULTRAMAR	AMERICAN	4	39.9 N	31.4 W	18	28	58	5 NM	95	996.6	9.0	12.8	9	19.5	27	12	47.5
SS SEALAND ECONOMY	AMERICAN	4	39.3 N	33.2 W	12	28	M 48	5 NM	01	999.3	8.9	16.7	7	29.5			
MV BERTHA FISSER	PANAMANIAN	5	42.8 N	21.5 W	00	25	30	2 NM	92	988.0	11.0		XX	41			
SS SEALAND ECONOMY	AMERICAN	5	36.5 N	38.7 W	12	24	M 42	5 NM	80	1007.1	13.6	17.3	6	16.5			
SS ULTRAMAR	AMERICAN	5	39.8 N	32.0 W	00	28	50	2 NM	89	1002.0	11.2	12.8	9	19.5	28	12	39
MV AXEL U	NORWEGIAN	7	46.0 N	13.4 W	12	27	45	> 25 NM	01	1015.0	13.0						
MV FERNGULF	NORWEGIAN	7	48.7 N	14.4 W	12	25	45	> 25 NM	01	1006.0	13.0	11.0	6	26			
MV AXEL U	NORWEGIAN	8	44.3 N	17.2 W	18	26	50	2 NM	81	996.2	13.0						
MV AXEL U	NORWEGIAN	9	44.0 N	18.0 W	00	34	45	10 NM	01	1009.0	11.0						
MV ATLANTICA LIVORNO	GERMAN	9	40.2 N	41.5 W	18	27	52	5 NM	27	1009.5	8.0	15.0	4	10	27	9	18
SS AMER ACCORD	AMERICAN	9	42.2 N	48.7 W	12	32	50	5 NM	01	1012.5	0.5	2.0	8	19.5			
SS LIGHTNING	AMERICAN	9	43.9 N	28.9 W	18	27	55	2 NM	07	982.8	9.4	12.3			27	8	16.5
SS TILLIE LYKES	AMERICAN	9	36.5 N	39.6 W	18	28	53	5 NM	01	1016.3	17.8	17.3			28	7	14.5
MV ATLANTICA LIVORNO	GERMAN	10	40.2 N	42.5 W	00	29	42	5 NM	01	1013.0	9.5	15.0	5	8	28	10	16.5
MV AXEL U	NORWEGIAN	10	41.3 N	21.5 W	00	27	43	5 NM	08	1008.0	17.0						
SS AMER LEGACY	AMERICAN	10	44.5 N	27.5 W	18	26	42	5 NM	89	1001.0	4.5	13.4	8	23			
MV AUSTRALIC	SWEDISH	10	44.7 N	17.5 W	12	22	45	5 NM	03	1007.5	15.0	14.0	15	32.5			
SS AMER LEADER	AMERICAN	10	47.7 N	39.7 W	06	27	50	1 NM	85		0.0	11.2	5	14.5	27	12	49
SS NEW JERSEY SUN	AMERICAN	10	48.6 N	19.7 W	18	23	41	5 NM	02	997.3	8.0	12.8	8	13	22	>13	19.5
SS AMER ACCORD	AMERICAN	10	43.2 N	44.6 W	00	30	60	2 NM	70	1009.0	3.8	16.7	10	19.5	29	9	24.5
MV KAREN MAERSK	DANISH	10	42.1 N	42.3 W	06	29	50	5 NM	25	1011.0	6.0	13.0			29	>13	16.5
SS LIGHTNING	AMERICAN	10	45.1 N	30.5 W	12	26	56	5 NM	02	997.3	8.9	12.3	6	16.5	26	9	32.5
MV FERNGULF	NORWEGIAN	10	47.5 N	26.3 W	06	28	64	10 NM	09	985.0	8.0		12	32.5			
MV FERNFIELD	NORWEGIAN	10	48.1 N	20.7 W	00	24	48	5 NM	60	979.5	14.2	13.0			29	9	24.5
SS AMER ALLIANCE	AMERICAN	10	50.0 N	28.5 W	06	23	60	2 NM	79	969.0	8.0	12.3	7	29.5	25	8	39
SS AMER ACE	AMERICAN	10	50.0 N	14.3 W	12	23	50	10 NM	02	986.5	8.3	11.1			23	8	42.5
SS SEALAND MC LEAN	AMERICAN	10	43.5 N	24.5 W	12	25	50	5 NM	02	1003.1	11.7	12.3			25	13	29.5
MV KAREN MAERSK	DANISH	11	41.5 N	33.4 W	12	29	41	10 NM	25	1007.0	10.0	16.0	4	6.5	31	>13	14.5
MV FERNFIELD	NORWEGIAN	11	47.7 N	21.2 W	00	30	50	2 NM	91	998.0	10.5				30	9	29.5
MV FERNGULF	NORWEGIAN	11	44.7 N	26.4 W	12	32	60	.5 NM	58	988.0	7.5	13.0	12	39			
SS LIGHTNING	AMERICAN	11	44.3 N	30.5 W	18	27	45	5 NM	02	1005.0	6.3	13.3	4	11.5	27	8	36
SS EXPORT LEADER	AMERICAN	11	41.8 N	38.9 W	18	28	59	10 NM	79	1015.9	6.6	23.3	9	19.5	34	9	19.5
SS AMER ACE	AMERICAN	11	50.2 N	17.5 W	06	23	55	5 NM	20	994.2	8.8	11.3	9	49			
SS SEALAND MARKET	NORWEGIAN	11	43.3 N	26.2 W	12	35	45	2 NM	02	981.4	6.7	12.0	8	11.5	35	8	21
MV AUSTRALIC	SWEDISH	11	48.5 N	13.8 W	06	22	45	5 NM	60	1013.0	13.0	13.0	15	49			
MV AXEL U	NORWEGIAN	11	39.1 N	23.5 W	06	22	50	5 NM	81	1001.5	16.0						
MV MOSENGEN	NORWEGIAN	11	47.2 N	10.0 W	18	21	M 46	5 NM	81	1000.0	15.0	15.0		19.5	24	X	32.5
SS SEALAND MC LEAN	AMERICAN	11	41.6 N	28.9 W	12	25	65	5 NM	02	1000.0	7.7	8.3			23	13	29.5
SS LIGHTNING	AMERICAN	12	44.1 N	38.1 W	00	30	50	5 NM	27	1010.5	5.5	19.4	7	24.5	27	8	32.5
MV MOSENGEN	NORWEGIAN	12	46.8 N	11.0 W	00	23	M 48	5 NM	81	1002.5	14.0	15.0		23	23	X	32.5
SS BIENVILLE	AMERICAN	12	38.7 N	53.5 W	18	25	41	5 NM	01	1012.2	20.6	21.3	7	24.5			
SS EXPORT FREEDOM	AMERICAN	12	38.3 N	55.4 W	18	24	35	5 NM	02	1005.1	21.0	20.0	5	14.5	28	8	18
MV FERNGULF	NORWEGIAN	12	43.2 N	29.4 W	12	28	45	10 NM	02	1010.0	11.0	12.0	9	23			
SS TILLIE LYKES	AMERICAN	12	38.9 N	52.5 W	12	24	45	5 NM	02	1009.1	20.6	20.6	3	8	25	< 6	14.5
SS EXPORT FREEDOM	AMERICAN	13	38.5 N	59.0 W	06	29	50	5 NM	64	1005.8	9.4	20.0	5	13	28	9	19.5
SS SEALAND MC LEAN	AMERICAN	13	40.2 N	53.8 W	12	29	80	1 NM	18	1003.7	10.0	10.0			29	< 6	16.5
SS TILLIE LYKES	AMERICAN	13	36.7 N	68.9 W	06	34	45	5 NM	01	1022.7	6.7	19.5	3	8	33	7	16.5
SS SEALAND MC LEAN	AMERICAN	12	41.8 N	38.2 W	12	23	45	2 NM	18	1000.0	11.2	13.9	7	24.5	26	13	24.5
SS AMER ACE	AMERICAN	14	45.8 N	48.0 W	12	29	47	5 NM	02	1011.5	- 0.1	4.4	6	14.5	29	7	23
SS SEALAND MC LEAN	AMERICAN	14	40.3 N	61.4 W	00	32	55	2 NM	18	1020.7	3.3	10.2	10	13	29	13	16.5
MV EDE SOTTORF	GERMAN	15	37.2 N	64.0 W	18	24	44	5 NM	50	1014.6	17.0				24	7	16.5
SS AMER ACE	AMERICAN	15	42.5 N	58.2 W	18	26	45	5 NM	02	1003.7	8.9	11.2	7	19.5	23	9	29.5
SS ADM W M CALLAGHAN	AMERICAN	16	40.1 N	49.1 W	18	20	55	5 NM	09	1007.3	17.8	19.0			22	< 6	11.5
SS AMER ARCHER	AMERICAN	16	45.7 N	39.3 W	12	22	48	2 NM	58	1007.8	12.5	14.5	6	11.5			
MV EDE SOTTORF	GERMAN	16	37.4 N	64.8 W	00	22	55	2 NM	97	1010.5	19.0		10	19.5	25	8	16.5
SS AMER ARCHER	AMERICAN	17	47.6 N	33.1 W	06	22	48	2 NM	50	1005.9	13.7	12.4	10	11.5			
MV BELLA MAERSK	DANISH	17	50.0 N	04.3 W	00	31	44	10 NM	01	1023.0	9.0		10	19.5			
SS AMER ARCHER	AMERICAN	18	48.9 N	26.6 W	00	20	46	2 NM	07	1018.3	12.7	12.3	8	13			
SS SEALAND MC LEAN	AMERICAN	18	42.0 N	57.7 W	12	34	48	5 NM	26	1013.2	- 1.2	15.6	3	6.5			
SS SEALAND MC LEAN	AMERICAN	19	44.2 N	40.8 W	12	32	45	5 NM	23	1004.1	0.6	15.6	9	10	32	13	11.5
MV ATLANTIC FOREST	NORWEGIAN	20	38.3 N	56.1 W	06	23	M 45	10 NM	02	1013.0	17.8				22	X	18
MV FROSTFJORD	NORWEGIAN	20	41.7 N	19.6 W	06	21	42	5 NM	07	1015.0	14.0						
MV BELLA MAERSK	DANISH	21	45.1 N	30.4 W	12	28	44	5 NM	02	1003.0	12.6		10	19.5			
SS AMER ACCORD	AMERICAN	24	48.6 N	28.0 W	12	22	45	5 NM	18	1003.0	11.7	11.7	8	21	27	X	24.5
SS AMER ACCORD	AMERICAN	25	47.0 N	34.5 W	12	27	50	2 NM	16	1000.0	8.3	12.3	10	24.5	28	9	29.5
SS NAGANO	LIBERIAN	26	47.1 N	30.0 W	12	27	58	5 NM	02	1005.0	7.8	12.2	6	16.5			
SS AMER ACCORD	AMERICAN	26	46.3 N	36.5 W	00	32	48	10 NM	18	1002.0	9.3	12.3	8	24.5	28	8	19.5
MV DAPHNE	SWEDISH	26	47.1 N	08.9 W	18	27	45	10 NM	25	1005.0	10.1	13.0	7	32.5	26	8	42.5
SS EXPORT PATRIOT	AMERICAN	26	47.5 N	24.6 W	18	27	41	10 NM	25	1002.4	9.5	12.3			27	>13	18
MV M P GRACE	LIBERIAN	27	46.1 N	16.6 W	12	32	45	2 NM	50	990.2	13.5	12.2	8	13			
SS NAGANO	LIBERIAN	27	47.1 N	31.6 W	12	32	55	5 NM	02	1001.0	3.3	11.7	6	16.5			
SS SEALAND MARKET	NORWEGIAN	27	48.5 N	15.8 W	18	23	50	10 NM	02	988.2	10.0	11.7			25	7	11.5
MV CARMEN	SWEDISH	27	49.5 N	10.6 W	18	20	50	2 NM	07	983.0	12.0	10.0	10	26			
MV FERNDALE	NORWEGIAN	27	45.1 N	26.1 W	18	27	50	5 NM	87	1003.0	9.0		9	16.5			
SS NAGANO	LIBERIAN	28	46.7 N	32.4 W	12	23	55	2 NM	07	1006.0	7.8	11.1	6	16.5			
SS NEW JERSEY SUN	AMERICAN	28	42.0 N	51.4 W	12	27	43	10 NM	01	1007.1	13.0	12.2	4	14.5	20	6	14.5
SS SEALAND ECONOMY	AMERICAN	28	44.3 N	23.3 W	06	28	M 41	10 NM	18	1009.1	5.5	12.2	7	11.5			
MV CARMEN	SWEDISH	28	49.5 N	11.7 W	00	20	55	10 NM	01	987.0	9.5	10.0	11	26			
SS EXPORT PATRIOT	AMERICAN	28	47.2 N	32.3 W	18	27	41	10 NM	82	984.1	12.2	11.7			27	13	19.5

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C.		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH ATLANTIC OCEAN		JAN.															
SS ADM W M CALLAGHAN	AMERICAN	29	39.9 N	34.2 W	06	23	60	2 NN	64	1008.2	13.5	16.2			25	8	19.5
MV M P GRACE	LIBERIAN	29	42.2 N	25.4 W	18	30	45	5 NN	02	1002.7	12.2	15.0	8	13	30	12	19.5
MV MAGDALENA	BRITISH	29	39.3 N	32.1 W	06	25	45	10 NN	00	1013.2	16.3	18.0	5	8	29	8	19.5
SS NAGAND	LIBERIAN	29	46.0 N	35.3 W	12	32	55	1 NN	07	1011.0	8.9	11.7	6	16.5			
SS WILLIAM T STEELE	AMERICAN	29	48.4 N	08.7 W	18	20	30	5 NN	02	997.6	11.0	11.2	10	16.5	19	11	23
SS SEALAND ECONOMY	AMERICAN	29	49.9 N	08.0 W	18	20	N 45	5 NN	02	999.0	8.3	10.6	7	11.5			
MV NAPINE	SWEDISH	29	41.7 N	21.3 W	12	23	45	1 NN	38	1001.8	13.0	16.0	8	39	30	12	44
MV CARMEN	SWEDISH	29	48.8 N	19.8 W	12	22	48	10 NN	61	978.0	9.5	12.0	12	23			
MV BELMUDSON	BRITISH	29	44.4 N	16.6 W	12	22	45	2 NN	61	998.2	5.0	11.0	11	13	22	7	29.5
SS NAGAND	LIBERIAN	30	45.2 N	40.8 W	12	27	55	5 NN	02	998.0	5.6	13.9	12	13			
SS WILLIAM T STEELE	AMERICAN	30	48.1 N	08.2 W	00	19	50	5 NN	03	991.9	11.2	11.2	12	19.5			
SS EXPORT PATRIOT	AMERICAN	30	46.4 N	45.6 W	18	29	47	10 NN	02	1010.8	0.0	2.9			29	10	10
MV FERNGULF	NORWEGIAN	30	41.5 N	42.8 W	12	28	48	10 NN	03	1012.0	14.0	16.0	7	26			
MV BELHUDSON	BRITISH	30	44.3 N	17.8 W	00	32	48	> 25 NN	01	996.3	9.0	11.0	8	13	32	8	26
MV CARMEN	SWEDISH	30	47.5 N	22.9 W	06	32	48	2 NN	07	1002.0	10.5	11.0		13			
SS NAGAND	LIBERIAN	31	45.3 N	44.3 W	06	32	50	5 NN	02	1022.0	1.1	6.1	12	13	32	6	16.5
SS WILLIAM T STEELE	AMERICAN	31	47.1 N	13.0 W	06	18	45	1 NN	51	991.5	8.8	11.7	10	26			
SS AMER LEGEND	AMERICAN	31	48.1 N	24.3 W	12	32	45	2 NN	02	992.0	9.4	11.1	9	13			
MV CARMEN	SWEDISH	31	46.0 N	27.5 W	06	34	45	2 NN	82	988.0	8.2	12.5	11	23	27	13	26
MV BELHUDSON	BRITISH	31	42.7 N	21.7 W	12	28	65	2 NN	64	1001.0	8.0	12.0	XX	19.5	28	>13	70
MV OGDEN THAMES	LIBERIAN	31	43.4 N	12.7 W	18	23	N 55	2 NN	81	993.2	12.2	14.0			25	< 6	16.5
SS NORTHFIELD	AMERICAN	31	40.3 N	21.0 W	12	27	47	5 NN	02	1012.9	12.8	13.0			27	12	29.5
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC INGHAM	AMERICAN	13	56.7 N	52.4 W	21	27	N 50	.5 NN	71	970.0	- 2.8	2.1	8	16.5			
USCGC INGHAM	AMERICAN	14	56.4 N	49.8 W	18	31	N 53	2 NN	85	986.1	- 3.9	2.5	9	19.5			
USCGC INGHAM	AMERICAN	16	57.1 N	51.1 W	12	07	N 46	1 NN	71	958.5	- 0.2	2.4	8	16.5			
USCGC INGHAM	AMERICAN	26	57.4 N	53.1 W	21	31	N 47	.5 NN	71	999.7	-10.6	0.9	9	14.5			
USCGC INGHAM	AMERICAN	27	56.8 N	51.1 W	12	31	N 55	2 NN	26	996.7	- 7.4	0.8	9	18			
USCGC INGHAM	AMERICAN	30	54.8 N	49.5 W	15	31	N 45	5 NN	26	998.2	- 4.4	2.4	7	13			
ATLANTIC H																	
USCGC CAMPBELL	AMERICAN	9	38.0 N	71.0 W	18	22	N 50	2 NN	80	1013.0	18.0	20.1	7	14.8			
USCGC TANEY	AMERICAN	27	38.0 N	71.0 W	12	22	N 41	5 NN	02	1018.2	23.0	20.8	7	13			
GREAT LAKES VESSELS																	
SS ARTHUR M ANDERSON	AMERICAN	6	47.6 N	88.1 W	00	28	N 44	5 NN	61		-11.0	4.0	7	6.5			
SS LEON FRASER	AMERICAN	14	47.3 N	89.5 W	18	26	N 42	5 NN	26		- 3.0	4.0	5	10			
NORTH ATLANTIC OCEAN		FEB.															
SS ADM W M CALLAGHAN	AMERICAN	1	40ww N	67.9 W	18	30	45	10 NN	03	1015.0	2.3	7.0	5	10			
SS JOSEPH D PUTTS	AMERICAN	1	42.2 N	63.7 W	12	31	45	5 NN	01	1002.4	0.3	1.6	6	8	28	7	14.5
SS EXPORT PATRIOT	AMERICAN	1	42.0 N	63.5 W	18	29	48	10 NN	02	1009.1	0.5	11.2	7	8	27	12	18
SS NAGAND	LIBERIAN	1	44.6 N	57.3 W	18	16	41	2 NN	02	998.0	2.8	2.2	6	13	27	6	16.5
MV OGDEN THAMES	LIBERIAN	1	44.3 N	11.2 W	00	25	N 53	2 NN	81	998.0	11.3	14.0			25	< 6	16.5
MV OGDEN THAMES	LIBERIAN	2	47.9 N	08.0 W	00	25	N 42	2 NN	02	1002.0	9.7	14.0	3	18			
USCGC INGHAM	AMERICAN	2	46.8 N	53.2 W	18	26	N 45	2 NN	85	1000.4	- 4.7	1.0	7	13			
SS AMER ARCHER	AMERICAN	3	40.1 N	40.6 W	06	26	47	5 NN	87	1004.6	13.3	13.2			28	11	23
SS NORTHFIELD	AMERICAN	3	42.8 N	39.6 W	18	23	42	10 NN	03	1014.7	15.0	15.6	9	10	26	13	23
SS NORTHFIELD	AMERICAN	4	42.8 N	40.9 W	00	23	45	5 NN	02	1010.5	15.6	16.2	9	10	29	6	26
SS LIGHTNING	AMERICAN	4	47.4 N	22.5 W	18	25	44	5 NN	02	1009.1	12.8	12.3			25	10	24.5
SS AMER ACCORD	AMERICAN	5	40.8 N	57.3 W	18	34	50	5 NN	07	987.5	11.7	14.4			24	8	24.5
SS EXPORT LEADER	AMERICAN	5	38.9 N	49.9 W	18	19	33	10 NN	02	1001.0	16.2	17.3	0	19.5	21	7	24.5
MV FERNDALE	NORWEGIAN	5	37.2 N	66.7 W	12	30	50	2 NN	02	1001.0	9.0		10	19.5			
MV BELHUDSON	BRITISH	5	37.7 N	51.1 W	12	19	45	10 NN	03	1009.2	16.0	19.0	4	10	21	9	19.5
MV CARMEN	SWEDISH	5	40.2 N	58.0 W	12	19	36	2 NN	13	998.6	19.2	18.0	8	16.5			
SS AMER ARCHER	AMERICAN	6	41.9 N	39.8 W	00	26	60	5 NN	87	985.4	3.0	15.0			26	X	41
SS ELIZABETHPORT	AMERICAN	6	38.1 N	61.0 W	00	27	35	5 NN	02	999.7	8.3	21.1	12	16.5			
MV LAKE EYRE	SWEDISH	6	41.8 N	36.6 W	06	27	60	2 NN	26	987.0	2.8	12.5			27	12	42.5
SS LASH TURKIYE	AMERICAN	6	39.0 N	59.6 W	06	27	50	2 NN	18	1000.3			7	29.5	27	7	30.5
SS NORTHFIELD	AMERICAN	6	43.5 N	53.7 W	12	27	36	5 NN	18	988.2	3.8	12.2	10	23			
MV FERNDALE	NORWEGIAN	6	37.3 N	66.8 W	00	30	45	2 NN	29	1011.5	3.0		9	16.5			
SS EXPORT LEADER	AMERICAN	6	38.7 N	53.0 W	18	28	70	1 NN	18	1001.7	14.0	19.2	7	29.5			
MV BELHUDSON	BRITISH	6	37.7 N	53.0 W	12	28	50	2 NN	02	1003.8	14.0	19.0	6	13	27	12	65.5
MV CARMEN	SWEDISH	6	39.6 N	58.6 W	12	40	55	2 NN	02	999.8	12.8	18.0	8	29.5			
MV ATLANTICA LIVORNO	GERMAN	7	39.8 N	45.7 W	12	28	47	5 NN	28	1005.5	10.3	13.0	5	8	27	10	14.5
MV LAKE EYRE	SWEDISH	7	41.7 N	39.6 W	00	31	55	2 NN	26	1010.3	4.3	14.0			31	>13	39
SS ORE MERCURY	LIBERIAN	7	36.2 N	73.0 W	18	25	46	10 NN	01	1029.8	22.0	22.0					
SS NORTHFIELD	AMERICAN	7	42.6 N	55.8 W	00	34	48	5 NN	81	1001.0	3.3	10.0	8	19.5	32	7	32.5
SS AMER ACCORD	AMERICAN	7	45.3 N	39.9 W	18	25	45	10 NN	03	991.8	6.1	13.3			25	9	19.5
SS AMER ARCHER	AMERICAN	7	41.3 N	58.4 W	00	32	48	5 NN	18	1008.5	4.3	13.5					
SS EXPORT LEADER	AMERICAN	7	38.2 N	53.6 W	06	29	75	1 NN	18	1012.5	14.4	19.2	6	29.5	27	7	32.5
MV BELHUDSON	BRITISH	7	38.1 N	53.1 W	00	27	48	5 NN	82	1009.0	17.0	19.0	4	13	27	10	65.5
MV CARMEN	SWEDISH	7	37.9 N	58.9 W	00	31	47	2 NN	03	1009.0	12.8	18.0	8	23			
USCGC INGHAM	AMERICAN	8	37.3 N	62.1 W	03	23	N 44	5 NN	07	1008.0	17.0	19.4	9	16.5			
MV ATLANTICA LIVORNO	GERMAN	8	40.3 N	52.3 W	18	30	50	5 NN	02	997.2	10.3	17.0	4	8	28	6	16.5
SS EXPORT LEADER	AMERICAN	8	39.0 N	59.1 W	06	26	70	5 NN	84	1000.3	15.3	19.4			26	7	29.5
MV CARMEN	SWEDISH	8	37.4 N	61.3 W	00	20	48	5 NN	02	1000.6	19.6	20.0	8	16.5			
SS SEALAND VENTURE	AMERICAN	8	38.5 N	43.6 W	18	23	45	5 NN	02	1000.5	17.5	17.2	3	6.5	23	10	19.5
SS WILLIAM T STEELE	AMERICAN	8	37.8 N	50.7 W	18	23	50	5 NN	23	1004.7	15.8	18.8	XX	14.5	24	10	24.5
SS ADM W M CALLAGHAN	AMERICAN	8	40.0 N	52.5 W	06	32	48	10 NN	03	1003.8	15.6	16.5	4	6.5	21	6	10
SS LIGHTNING	AMERICAN	9	42.5 N	43.2 W	00	27	30	2 NN	05	993.8	8.4	15.6	10	29.5			
SS AMER RANGER	AMERICAN	9	33.3 N	58.3 W	18	32	48	5 NN	05	1008.7	22.2	18.9	4	10	23	9	19.5
USCGC INGHAM	AMERICAN	9	37.0 N	57.3 W	06	34	N 56	2 NN	80	998.5	20.2	20.3	10	19.5			
MV SIRA	NORWEGIAN	9	40.3 N	11.7 W	00	22	48	5 NN	03	1009.0	12.8	12.0	4	13			
MV BELHUDSON	BRITISH	9	36.9 N	66.3 W	12	25	35	5 NN	02	996.0	19.0	19.0	4	13	25	9	54
MV CARMEN	SWEDISH	9	37.0 N	69.7 W	06	22	35	5 NN	02	996.5	16.5	20.0	10	19.5			
SS TETELA	HONDURAN	9	42.2 N	34.7 W	12	27	48	1 NN	01	998.0	14.5	14.5	8	16			
SS WILLIAM T STEELE	AMERICAN	9	39.8 N	54.5 W	18	27	45	10 NN	01	990.2	15.7	15.7			XX	X	16.5
SS SEALAND VENTURE	AMERICAN	9	39.2 N	41.0 W	00	22	N 43	5 NN	20	1000.2	17.9	18.9	3	16.5	22	9	29.5
SS AMER ACCORD	AMERICAN	9	49.2 N	21.7 W	18	30	47	2 NN	18	972.2	10.8	13.4	7	16.5			
MV ATLANTIC FOREST	NORWEGIAN	9	42.3 N	20.3 W	18	21	N 42	5 NN	02	1003.0	14.0			19.5	23	X	26
MV SIRA	NORWEGIAN	10	43.1 N	13.1 W	00	18	34	5 NN	29	1000.0	12.0	12.0	8	19.5			
MV HOEGH MALLARD	NORWEGIAN	10	42.8 N	20.3 W	18	21	N 32	2 NN	18	980.3	16.0	16.0					
MV FROSTFJORD	NORWEGIAN	10	41.4 N	40.1 W	12	30	55	5 NN	03	1006.0	12.0						
SS ALMERICA LYKES NEW	AMERICAN	10	42.8 N	26.3 W	18	28	78	.5 NN		999.0	11.8	12.7			28	10	16.5

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH ATLANTIC OCEAN		FEB.															
SS SEALAND VENTURE	AMERICAN	10	43.1 N	23.0 W	18	24 M	68	5	NM	81	976.0	13.3	12.8			24	12	32.5
SS AMER ACCORD	AMERICAN	10	49.5 N	19.5 W	00	22	55	2	NM	82	970.0	8.3	11.1			22	8	29.5
SS ADM W M CALLAGHAN	AMERICAN	10	40.6 N	28.3 W	18	28	50	5	NM	01	998.0	14.0	13.0	9	23			
MV ATLANTIC FOREST	NORWEGIAN	10	40.7 N	24.7 W	12	23 M	42	2	NM	82	994.0	16.7	17.0		16.5	25	X	29.5
SS AMER ACE	AMERICAN	10	50.6 N	27.5 W	06	30	60	5	NM	09	973.2	7.3	11.1			30	8	65.5
SS ORE NEPTUNE	LIBERIAN	11	42.8 N	19.8 W	00	29	50	5	NM	01	984.5	11.4	13.3	8	19.5	27	>13	32.5
MV SIRA	NORWEGIAN	11	45.9 N	18.2 W	00	25	54	5	NM	25	971.0	12.0	13.0	9	24.5			
MV HOEGH MALLARD	NORWEGIAN	11	43.5 N	19.1 W	00	28 M	65	2	NM	18	981.0	12.0	13.0					
SS AMER ACE	AMERICAN	11	48.7 N	39.5 W	12	27	50	5	NM	02	997.0	4.4	11.1			27	8	32.5
SS SEALAND VENTURE	AMERICAN	11	43.7 N	20.4 W	00	29 M	55	5	NM	21	986.8	10.0	12.8			29	9	32.5
MV FROSTFJORD	NORWEGIAN	12	49.1 N	19.9 W	18	29	55	2	NM	89	996.0	8.0			29.5			
SS EXECUTOR	AMERICAN	12	35.9 N	67.1 W	12	30	45	5	NM	18	1011.2	10.6	19.4	5	14.5	30	6	23
SS AMER ACE	AMERICAN	12	47.9 N	43.3 W	00	24	50	5	NM	26	1007.1	- 1.7	12.2	7	28	23	10	31
MV FROSTFJORD	NORWEGIAN	13	49.5 N	17.3 W	00	30	55	2	NM	89	995.0	8.0						
SS AMER LEGEND	AMERICAN	13	46.1 N	17.3 W	00	29	45	5	NM	03	1003.7	5.6	10.6	5	14.5			
USCGC EDISTO	AMERICAN	13	51.0 N	41.8 W	12	03 M	42	1	NM	07	982.6	3.8	8.2	6	10			
MV SIRA	NORWEGIAN	14	39.2 N	29.2 W	18	30	50	10	NM	02	1025.0	13.0	13.0	7	19.5			
MV BELLA MAERSK	DANISH	14	48.2 N	13.7 W	18	24	45	5	NM	02	978.0	11.0		10	19.5			
SS AMER LEGEND	AMERICAN	14	44.5 N	27.1 W	18	28	55	5	NM	18	1005.0	10.6	11.7	8	39			
SS JOSEPH D POTTS	AMERICAN	14	36.0 N	63.9 W	12	23	45	2	NM	02	1015.9	17.5	18.0			23	9	11.5
MV NORDFOTT	NORWEGIAN	14	43.5 N	20.0 W	18	26	56	5	NM	02	1010.0	11.0	9.0	8	32.5			
MV OGDEN THAMES	LIBERIAN	14	46.1 N	07.3 W	18	21 M	30	1	NM	65	993.5	12.5	13.0	4	16			
SS AMER LEGEND	AMERICAN	15	44.4 N	28.3 W	00	29	50	5	NM	18	1017.3	10.0	11.7	7	32.5			
SS STAGHOUND	AMERICAN	15	52.5 N	23.9 W	00	33	55	2	NM	02	982.7	6.5				30	10	29.5
USNS VICTORIA	AMERICAN	15	45.0 N	18.1 W	18	31	45	5	NM	02	1004.7	10.6	11.2	4	10	30	10	28
MV SEFRA	NORWEGIAN	15	45.4 N	13.9 W	18	28	48	5	NM	80	999.0	10.5	12.0	8	32.5			
SS SEALAND MC LEAN	AMERICAN	15	47.1 N	21.9 W	12	30	45	5	NM	02	1007.8	12.3	11.1	12	13			
MV NORDFOTT	NORWEGIAN	15	44.8 N	16.9 W	06	30	48	10	NM	15	999.0	12.0	12.0	9	32.5	27	11	32.5
MV OGDEN THAMES	LIBERIAN	15	44.5 N	08.4 W	06	24 M	45	10	NM	01	993.8	11.8	14.0	6	19.5			
SS SEALAND MARKET	NORWEGIAN	15	48.8 N	11.7 W	12	27	50	10	NM	02	988.2	14.4	11.2	8	16.5	27	9	18
MV BELLA MAERSK	DANISH	15	47.4 N	16.4 W	18	31	55	5	NM	02	999.7	11.0		13	23	31	>13	39
SS WILMINGTON GETTY	AMERICAN	16	32.9 N	75.8 W	21	28	50	2	NM	07	999.7	18.3	23.3			28	>13	19.5
MV SEFRA	NORWEGIAN	16	44.9 N	15.2 W	06	30	45	5	NM	02	1015.0	11.0	12.0	7	26			
SS SEALAND MARKET	NORWEGIAN	16	44.8 N	14.0 W	00	33	50	5	NM	25	1005.1	10.0	11.5	9	16.5	33	9	19.5
MV BELLA MAERSK	DANISH	16	47.2 N	17.2 W	00	32	50	5	NM	02	1010.7	10.0		10	23	31	11	32.5
USCGC TANEY	AMERICAN	17	37.7 N	73.5 W	09	34 M	70	1	NM	81	968.5	15.6	23.3	7	11.5	18	11	19.5
USNS PECOS	AMERICAN	17	32.4 N	67.8 W	12	22	47	5	NM	16	1000.3	18.9	22.2	3	13			
SS WILMINGTON GETTY	AMERICAN	17	31.8 N	76.0 W	06	29	48	5	NM	02	1003.0	20.0	20.0			29	>13	19.5
SS TRANSIDAHO	AMERICAN	17	35.4 N	71.7 W	06	25	48	2	NM	15	989.5	16.2	21.2	5	8	14	8	19.5
SS STAGHOUND	AMERICAN	17	49.3 N	39.0 W	00	18	50	1	NM	56	986.1	3.0	12.0	3	10	18	6	18
SS BOSTON	AMERICAN	17	38.7 N	71.6 W	12	27	63	.5	NM	82	987.5	13.4	23.3	9	19.5			
SS EXPORT LEADER	AMERICAN	17	37.0 N	67.1 W	12	20	50	5	NM	02	987.8	18.3	22.2			20	8	11.5
SS LIGHTNING	AMERICAN	18	42.6 N	43.0 W	18	21	50	1	NM	16	989.5	15.0	18.6			32	10	32.5
USNS PECOS	AMERICAN	18	32.6 N	69.8 W	00	31	43	5	NM	01	1003.4	14.4	19.4	3	13	27	< 6	13
MV SIRA	NORWEGIAN	18	32.9 N	52.7 W	18	23	44	2	NM	25	1004.0	18.0	19.0	5	16.5			
SS BOSTON	AMERICAN	18	34.8 N	69.9 W	00	29	45	5	NM	02	1001.7	15.7	19.0	6	19.5			
SS DEFIANCE	AMERICAN	18	40.2 N	63.4 W	00	20	75	1	NM		968.0	11.1	11.1	6	41			
SS EXPORT LEADER	AMERICAN	18	36.7 N	63.1 W	00	27	50	5	NM	50	995.0	15.2	20.0	8	14.5	27	12	24.5
MV SERAPIN TOPIC	LIBERIAN	20	34.0 N	72.6 W	06	19	57	5	NM	63	1003.0	18.0	20.0	13	19.5			
MV BELLA MAERSK	DANISH	21	40.8 N	57.5 W	18	31	45	5	NM	02	1009.8	8.0		8	24.5			
USCGC GALLATIN	AMERICAN	21	51.6 N	45.0 W	18	23 M	43	2	NM	07	1012.2	5.1	6.7	5	11.5			
USCGC GALLATIN	AMERICAN	22	51.0 N	44.8 W	00	20 M	46	1	NM	07	1007.2	7.7	8.2	5	13			
USNS PECOS	AMERICAN	22	33.4 N	73.2 W	12	18	42	10	NM	03	1012.5	19.4	19.3			18	< 6	8
MV BELLA MAERSK	DANISH	23	40.5 N	69.8 W	18	28	45	5	NM	02	1002.2	5.9		6	19.5			
SS BROOKLYN	AMERICAN	23	38.0 N	74.0 W	12	27	50	10	NM	02	1009.8	6.2	11.7	2	14.5			
MV MONMOUTH	AMERICAN	23	36.7 N	74.6 W	12	30	45	> 25	NM	00	1011.2	7.8	9.5	5	8	30	< 6	18
USNS PECOS	AMERICAN	23	34.3 N	74.7 W	00	20	45	2	NM	17	1002.7	22.2	22.2	3	14.5			
SS AMER LEGACY	AMERICAN	24	42.2 N	56.3 W	18	30	45	5	NM	05	1010.0	3.5	11.0			30	7	34.5
SS KEYTANKER	AMERICAN	24	39.4 N	68.8 W	00	23	45	5	NM	01	1010.0	6.5	6.0	5	11.5	23	10	21
USCGC GALLATIN	AMERICAN	24	43.8 N	53.9 W	18	26 M	43	5	NM	02	1007.3	2.0	8.7	6	11.5			
SS ZIM NEW YORK	GERMAN	25	40.4 N	56.2 W	00	27	41	5	NM	02	1018.0	12.0	19.0	11	19.5			
SS SEALAND VENTURE	AMERICAN	25	20.1 N	87.0 W	12	35 M	45	10	NM	03	1025.0	10.7	26.7	2	6.5	35	7	13
SS WILMINGTON GETTY	AMERICAN	26	28.0 N	79.7 W	12	34	48	10	NM	02	1022.4	14.7	22.2			35	>13	18
OCEAN STATION VESSELS																		
ATLANTIC B																		
USCGC GALLATIN	AMERICAN	1	56.5 N	50.7 W	21	26 M	52	5	NM	02	983.5	1.0	3.9	11	19.5			
USCGC GALLATIN	AMERICAN	2	56.5 N	50.2 W	00	12 M	56	.5	NM	71	977.5	1.3	3.9	9	21			
USCGC GALLATIN	AMERICAN	7	57.4 N	49.0 W	21	05 M	51	5	NM	07	1005.6	1.8	2.6	8	21			
USCGC GALLATIN	AMERICAN	8	57.4 N	49.0 W	00	05 M	44	5	NM	07	1007.8	1.0	2.6	8	19.5			
USCGC GALLATIN	AMERICAN	15	56.0 N	50.5 W	21	22 M	43	2	NM	71	990.1	-10.0	2.0	6	19.5			
USCGC GALLATIN	AMERICAN	16	55.8 N	50.5 W	00	21 M	44	1	NM	71	990.0	- 7.0	2.0	6	19.5			
USCGC CAMPBELL	AMERICAN	23	56.5 N	51.0 W	00	34 M	48	1	NM	88	982.0	- 0.6	1.8	8	16.5			
ATLANTIC M																		
USCGC INGHAM	AMERICAN	5	38.2 N	69.5 W	18	30 M	46	.25	NM	86	1012.0	3.3	20.2	8	14.5			
USCGC INGHAM	AMERICAN	6	38.2 N	69.8 W	00	30 M	44	2	NM	07	1017.6	4.8	19.0	7	14.5			
USCGC DUANE	AMERICAN	17	38.0 N	71.0 W	15	32 M	36	.25	NM	05	988.0	9.6	15.6	9	26			
USCGC TANEY	AMERICAN	18	38.0 N	71.0 W	00	30 M	43	5	NM	02	1001.2	8.0	19.1	11	23			
USCGC DUANE	AMERICAN	20	38.0 N	71.0 W	03	19 M	48	2	NM	61	1004.4	18.1	21.2	9	16			
USCGC DUANE	AMERICAN	23	37.8 N	71.1 W	06	27 M	36	1	NM	13	999.6	16.2	22.9			22	10	14.5

< Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 11
U.S. Ocean Station Vessel Climatological Data, North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W January and February, 1974

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JAN	15.4	16 00	18.7	21.6	18 00	6.0	04 18	14.9	20.1	18 00	15.0	29 18	19.5	21.7	05 09	- 4.0	05 09	- 1.1	2.9	14 15
FEB	15.0	28 12	18.0	20.9	21 00	7.6	10 03	12.0	17.3	01 00	17.4	06 18	19.0	21.1	22 06	- 4.6	22 06	- 1.0	1.7	28 00

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL PCPN	SNOW	TSTM	VERY <34KN **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	LOBS WITH PCPN	NO OF OBS
JAN	1000.2	10 00	1013.4	1028.9	29 18	3.5	16.4	37.4	32.7	23.9	29.4	21.9	32.8	13	18	0	0	4	5	2	0	24	23.4	201
FEB	1009.8	28 00	1024.3	1031.2	16 21	13.5	18.9	40.5	27.0	31.4	24.9	24.9	18.9	8	8	0	0	0	0	0	0	21	7.5	189

** VV-90-93 AND/OR W-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

JAN WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.0	1.7	.0	.0	.0	3.4	10.9
NE	.0	5.8	1.6	.1	.0	.0	7.3	9.4
E	.0	4.2	11.6	.2	.0	.0	20.0	14.6
SE	.0	3.7	9.7	.1	.0	.0	13.5	13.1
S	.0	.0	13.3	0.0	1.4	.4	21.0	21.3
SW	.0	2.0	9.1	7.3	2.1 *	.8	20.3	22.9
W	.0	1.0	4.0	2.0	.0	.0	9.0	18.5
NW	.0	1.2	1.2	.0	.0	.0	2.5	9.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	21.4	50.2	29.9	3.5	1.0	100.0	17.8

NUMBER OF OBS 201 | MAX WIND DIR 200 | SPEED 50 | DA HR 14 2100 | VECTOR SPEED 8.1 | MEAN DIR 178 | (DIR IN DEGREES)

FEB WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	1.1	1.9	.0	.0	.0	.0	2.9	9.3
NE	1.1	4.7	4.2	1.2	.0	.0	11.2	12.1
E	.0	9.9	20.4	3.0	.0	.0	33.3	13.8
SE	.3	6.5	11.8	.8	.0	.0	19.6	13.1
S	.0	4.3	3.8	.0	.0	.0	8.1	10.8
SW	.1	2.8	3.1	1.1	.0	.0	6.9	12.7
W	1.8	1.1	.0	.0	.0	.0	2.8	6.3
NW	.8	3.2	1.1	.0	.0	.0	5.1	8.8
CALM	9.2	.0	.0	.0	.0	.0	9.2	.0
TOTAL	15.1	34.1	44.3	6.3	.0	.0	100.0	11.4

NUMBER OF OBS 183 | MAX WIND DIR 340 | SPEED 20 | DA HR *27 1800 | VECTOR SPEED 7.0 | MEAN DIR 103 | (DIR IN DEGREES)

Wave

JAN WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.0	.0	1.0	2.2	.0	.0	.0	4.2
NE	.0	4.0	.5	.0	.0	.0	.0	.0	4.5
E	.0	10.4	3.2	2.3	.0	.0	.0	.0	16.2
SE	.5	6.5	3.9	2.0	.0	.0	.0	.0	14.9
S	.0	5.3	5.5	4.5	.7	.0	.0	.0	19.7
SW	.0	2.5	4.5	1.4	5.8	.0	.0	.0	14.4
W	.0	.5	13.6	2.5	3.1	.0	.0	.0	19.7
NW	.0	.5	2.1	3.0	3.5	.0	.0	.0	9.1
IND	.0	.0	.5	.5	.0	.0	.0	.0	1.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.5	32.8	33.8	17.4	15.4	.0	.0	.0	100.0

NUMBER OF OBS 201 IND=INDETERMINATE

FEB WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.9	2.0	1.1	.0	.0	.0	.0	5.0
NE	.3	.9	.0	.0	.0	.0	.0	.0	1.2
E	5.1	21.6	.0	.0	.0	.0	.0	.0	26.6
SE	.0	11.5	.0	.0	.0	.0	.0	.0	11.5
S	.4	.0	.0	.0	.0	.0	.2	.0	.4
SW	.1	.0	.5	.0	.0	.0	.0	.0	.7
W	.0	2.7	2.4	.9	.0	.0	.0	.0	6.1
NW	.5	36.5	10.6	.0	.0	.0	.0	.0	47.6
IND	.3	.0	.0	.0	.0	.0	.0	.0	.3
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	7.0	75.1	16.2	1.9	.0	.0	.2	.0	100.0

NUMBER OF OBS 183 IND=INDETERMINATE

JAN WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.5	29.4	3.5	2.3	.0	.0	.0	.0	35.9
6-7	.0	1.5	24.9	13.4	3.0	.0	.0	.0	42.8
8-9	.0	1.0	3.0	1.3	11.9	.0	.0	.0	19.4
10-11	.0	1.0	.0	.0	.0	.0	.0	.0	1.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.5	.0	.0	.0	.5
IND	.0	.0	.5	.5	.0	.0	.0	.0	1.0
TOTAL	.5	32.9	31.8	17.4	15.4	.0	.0	.0	100.0

NUMBER OF OBS 201 | MAX WAVE HEIGHT HGT 5.5 | PER 8 | DIR 200 | TYPE ST4 | DA HR 14 21 | (DIR IN DEGREES) IND=INDETERMINATE

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

FEB WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	7.0	31.9	.0	.0	.0	.0	.0	.0	38.9
6-7	.0	36.8	12.4	.0	.0	.0	.0	.0	49.2
8-9	.0	6.5	2.2	.9	.0	.0	.0	.0	9.8
10-11	.0	.0	1.0	.0	.0	.0	.0	.0	1.0
12-13	.0	.0	.0	1.1	.0	.0	.0	.0	1.1
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	7.0	75.1	16.2	1.9	.0	.0	.2	.0	100.0

NUMBER OF OBS 183 | MAX WAVE HEIGHT HGT 3.0 | PER 12 | DIR 92c | TYPE SW1 | DA HR 24 00 | (DIR IN DEGREES) IND=INDETERMINATE

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 12
Selected Gale Observations, North Pacific
January and February 1974

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH PACIFIC OCEAN		JAN.															
MV OGDEN THAMES	LIBERIAN	1	40.3 N	146.1 W	00	10 M	30	1	NH	21	1016.5	11.8	13.0	5	16.5		
SS PRES TAFT /NEW/	AMERICAN	1	31.0 N	168.3 W	06	24	32	8	NH	97	986.5	19.4	17.8				
SS ZIM NEW YORK	GERMAN	3	40.4 N	138.4 W	06	21	85	5	NH	05	992.1	12.2	14.0	14	26		
SS SANTA CLARA	AMERICAN	3	43.0 N	129.2 W	12	02	50	5	NH	25	1019.3	6.7	14.0		32.5		
SS ZIM NEW YORK	GERMAN	4	40.6 N	130.4 W	09	11	55	1	NH	02	1006.5	12.8	13.0			14	>13 32.5
MV ASIA HOMO	LIBERIAN	4	38.0 N	147.5 W	06	12 M	43	5	NH	02	1015.0	15.0	13.0	8	13	12	10 19.5
MV TRANSOCEAN TRANSPORT	PHILIPPINE	4	37.8 N	148.5 W	06	11 M	42	2	NH	03	1014.2	14.0	13.7	8	13	11	11 16.5
SS WYOMING	AMERICAN	5	29.2 N	173.5 W	18	29	50	2	NH	07	996.2	18.5	20.0	12	32.5		
MV WORLD PELAGIC	LIBERIAN	5	39.0 N	170.3 W	18	11	43	10	NH	02	990.0	13.2	14.0			XX	X 23
SS AMER APOLLO	AMERICAN	5	37.9 N	144.8 W	00	13	45	9	NH	02	1014.9	12.8	13.9	6	16.5	11	6 19.5
MV ROSE	LIBERIAN	5	34.0 N	177.5 E	18	33 M	48	2	NH	03	1004.3	13.0	18.5				
MV BRYNJE	NORWEGIAN	5	30.6 N	178.6 W	06	22	50	5	NH	03	990.0	20.0					
SS EXPORT CHAMPION	AMERICAN	5	34.0 N	169.8 W	12	14	30	2	NH	82	982.7	13.9	13.3			14	>13 29.5
MV GRAND HOLLY	PANAMANIAN	5	34.1 N	165.2 W	18	13	60	50	YD	97	988.0	16.0	17.0			13	>13 13
MV SKOGSTAD	NORWEGIAN	6	33.2 N	170.4 W	06	25	43	2	NH	80	987.0	16.5					
MV UNION EXPANSION	LIBERIAN	6	35.2 N	172.5 W	00	28	49	.5	NH	07	984.7	14.0	17.0	5	10	25	9 23
SS WYOMING	AMERICAN	6	29.3 N	174.1 W	12	29	50	5	NH	03	1002.4	15.6	19.4		36		
MV WAY WAY	LIBERIAN	6	41.6 N	165.8 W	06	09 M	42	2	NH	08	995.5	12.2	10.6			09	8 6.5
MV WORLD PELAGIC	LIBERIAN	6	39.4 N	165.5 W	18	07	45	2	NH	81	986.5	11.3	13.0			08	X 39
SS AMER ASTRONAUT	AMERICAN	6	38.4 N	178.6 W	18	34	50	5	NH	16	1001.4	10.7	13.7	6	10	34	7 16.5
MV ASIA HOMO	LIBERIAN	6	34.3 N	157.7 W	06	11 N	41	2	NH	82	999.2	14.0	16.0			12	8 19.5
MV ROSE	LIBERIAN	6	32.7 N	172.6 W	18	34 M	45	9	NH	03	999.8	13.8	19.0				
MV PLUTOS	GERMAN	6	35.5 N	146.8 E	06	30	55	10	NH	18	1006.0	9.3	18.0	11	13		
SS SEATRAIN GEORGIA	AMERICAN	6	29.6 N	168.2 W	18	26	50	5	NH	81	990.5	15.6	16.7	8	10	29	< 6 23
SS SINCLAIR TEXAS	AMERICAN	6	42.9 N	129.0 W	00	03	48	5	NH	15	1001.8	5.0	8.3			04	8 13
MV BRYNJE	NORWEGIAN	6	29.0 N	171.3 W	12	28	60	5	NH	82	999.0	16.0					
MV GRAND HOLLY	PANAMANIAN	6	33.6 N	167.3 W	12	33	60	.25	NH	81	970.0	17.0	18.0	XX	28	25	>13 32.5
MV JOHAN U	NORWEGIAN	6	30.9 N	164.2 W	18	26	45	5	NH	25	983.5	15.5	20.0	10	29.5		
SS SEALAND GALLOWAY	AMERICAN	7	39.0 N	163.2 E	06	28	50	5	NH	80	991.5	11.2	15.0			28	12 49
MV WORLD PELAGIC	LIBERIAN	7	39.4 N	165.6 W	00	04	65	2	NH	81	987.5	12.5	13.0			06	X 42.5
SS AMER ASTRONAUT	AMERICAN	7	37.5 N	178.9 W	00	34	50	5	NH	18	1004.1	12.2	14.4	6	10	34	7 16.5
MV ROSE	LIBERIAN	7	32.4 N	174.6 W	00	30 M	45	5	NH	03	997.5	15.3	18.5				
SS SEATRAIN GEORGIA	AMERICAN	7	29.1 N	165.5 W	06	29	55	5	NH	02	987.1	17.3	20.0			29	6 29.5
MV BRYNJE	NORWEGIAN	7	27.5 N	167.8 W	06	29	60	5	NH	82	996.0	17.0					
USNS FURMAN	AMERICAN	7	30.4 N	173.3 W	00	30 M	50	5	NH	02	999.0	17.2	21.1	5	19.5	30	7 36
MV GRAND HOLLY	PANAMANIAN	7	33.5 N	168.6 W	00	31	52	2	NH	07	975.0	18.0	18.0	17	26	30	>13 32.5
MV JOHAN U	NORWEGIAN	7	30.9 N	164.5 W	00	26	36	5	NH	25	979.0	16.5	20.0	9	29.5	26	8 34.5
SS JAPAN BEAR	AMERICAN	7	42.5 N	132.1 W	00	10 N	45	5	NH	09	1008.5	10.0	7.8			10	12 11.5
MV ORIENTAL DESTINY	LIBERIAN	7	40.7 N	133.9 W	12	11	30	2	NH	31	998.3	10.5	11.2				
SS WASHINGTON MAIL	AMERICAN	8	49.1 N	161.9 E	00	10	48	5	NH	02	993.2	3.9	2.8	9	24.8		
USNS FURMAN	AMERICAN	8	28.4 N	179.9 E	00	28 N	48	5	NH	02	996.3	21.1	20.6			27	7 14.5
MV JOHAN U	NORWEGIAN	8	30.8 N	166.1 W	00	28	48	> 25	NH	25	992.0	17.0	20.0	8	28	28	10 32.5
MV ORIENTAL DESTINY	LIBERIAN	8	40.7 N	149.0 W	12	11	45	2	NH	31	1005.4	10.4	12.2				
MV WORLD PELAGIC	LIBERIAN	8	42.4 N	134.8 W	06	10	45	1	NH	85	989.5	10.5	10.0			18	X 29.5
SS CHEVRON HAWAII	AMERICAN	9	28.0 N	157.5 W	06	31	41	10	NH	16	996.0	19.4	20.0	5	11.5	29	8 19.5
SS SEALAND GALLOWAY	AMERICAN	10	44.1 N	148.9 W	12	11	30	1	NH	41	986.8	10.0	8.3			11	8 19.5
MV HAKONE MARU	JAPANESE	10	28.9 N	159.1 W	00	27 M	42	2	NH	44	998.0	20.0	20.0	6	6.5	27	12 16.5
MV CLIFFORD MAERSK	DANISH	10	13.2 N	130.7 E	03	03	46 (W)	1	NH	62	1002.0	24.6	27.8	XX	23	05	X 32.5
SS CHEVRON HAWAII	AMERICAN	10	35.1 N	156.7 W	12	31	48	5	NH	62	992.0	14.4	14.4			29	10 24.5
MV ROSE	LIBERIAN	10	34.3 N	151.6 W	18	27 M	41	5	NH	01	996.0	19.0	17.3				
MV WAY WAY	LIBERIAN	10	45.2 N	146.9 W	12	10 M	45	.5	NH	58	997.5	11.0	10.7			11	9 6.5
MV WORLD PELAGIC	LIBERIAN	10	44.0 N	148.6 W	12	09	55	1	NH	80	986.0	10.5	9.0			09	X 29.5
SS AMER ASTRONAUT	AMERICAN	10	46.9 N	147.2 W	06	12	46	5	NH	02	1005.1	7.2	7.2			12	7 13
MV ORIENTAL DESTINY	LIBERIAN	10	39.1 N	139.1 W	12	12	41	10	NH	02	1005.4	13.2	13.9				
SS CHEVRON HAWAII	AMERICAN	11	37.3 N	155.2 W	00	25	49	5	NH	50	986.8	12.7	12.2	4	6.5	29	9 21
MV WORLD PELAGIC	LIBERIAN	11	44.2 N	148.5 W	06	09	60	2	NH	07	985.3	10.5	9.0			10	X 32.5
SS MONTEREY	AMERICAN	11	32.0 N	128.8 W	06	18	45	5	NH	50	1008.5	17.8	17.8	5	10	18	< 6 16.5
MV MONTIRON	LIBERIAN	13	33.8 N	151.9 W	12	26 M	47	2	NH	02	998.9	16.0	16.0	10	19.5	26	12 23
SS OREGON MAIL	AMERICAN	13	38.9 N	168.0 E	06	27	45	10	NH	02	983.4	10.6	10.0	9	8	29	7 13
SS CHEVRON CALIFORNIA	AMERICAN	14	27.5 N	144.8 W	18	23	55	1	NH		1003.5	21.7	19.3			23	8 13
SS SEALAND FINANCE	AMERICAN	14	47.2 N	144.7 W	00	08	45	2	NH	26	998.9	2.2	7.2	10	19.5		
SS TRANSCOLORADO	AMERICAN	14	29.0 N	142.0 W	18	23	47	5	NH	02	1004.7	21.1	20.6	10	29.5		
SS PRES POLK	AMERICAN	14	29.3 N	140.5 E	06	32	42	5	NH	21	1009.5	19.3	18.3	8	13		
SS PRES MONROE	AMERICAN	14	47.3 N	128.1 W	06	07	47	1	NH	02	989.1	2.2	7.2	10	23	34	8 18
MV LIECHTENSTEIN	LIBERIAN	14	37.8 N	153.7 W	00	24 N	48	2	NH	02	977.0	13.3	13.3	10	19		
MV MONTIRON	LIBERIAN	14	33.3 N	153.9 W	06	33 N	60	2	NH	64	997.5	18.0	18.0			33	9 29.5
MV MONTIRON	LIBERIAN	15	33.4 N	156.4 W	00	29 N	42	5	NH	02	999.5	17.0	17.0	5	26	29	12 29.5
SS HAWAIIAN CITIZEN	AMERICAN	15	39.2 N	139.1 W	06	21	48	5	NH	02	982.1	14.0	14.0			21	10 29.5
SS CHEVRON CALIFORNIA	AMERICAN	15	26.9 N	146.2 W	00	24	54	5	NH	02	1002.6	19.4	18.3			24	8 13
SS COLORADO	AMERICAN	15	35.3 N	138.7 W	00	20	45	.5	NH	59	994.8	15.6	15.6			19	9 13
MV PLUTOS	GERMAN	15	36.1 N	129.7 W	12	17	41	5	NH	28	1003.0	16.0	18.2	8	10		
SS TRANSCOLORADO	AMERICAN	15	28.8 N	149.3 W	00	26	46	5	NH	03	1002.4	20.0	20.6	11	26		
MV TOYOTA MARU # 10	JAPANESE	15	32.0 N	139.0 W	06	19 N	42	2	NH	02	1007.0	20.0	18.0				
MV HAVIS	NORWEGIAN	16	53.0 N	142.3 W	18	28	45	10	NH	26	982.0	- 2.0	5.5			30	11 26
SS HAWAIIAN CITIZEN	AMERICAN	16	37.5 N	138.5 W	00	22	50	5	NH	02	988.8	14.5	14.5	6	11.5	22	8 29.5
SS RED JACKET	AMERICAN	16	33.2 N	166.4 E	06	29	45	10	NH	16	1003.4	15.6	16.7	2	10	28	9 19.5
MV HAVIS	NORWEGIAN	17	34.0 N	149.7 W	00	28	45	5	NH	26	981.0	- 1.0	5.5			29	X 26
SS PRES FILLMORE /NEW/	AMERICAN	17	39.4 N	146.1 E	06	29	41	5	NH	26	1003.7	2.2	10.0			29	< 6 8
MV THOMAS G THOMPSON	AMERICAN	17	35.6 N	151.0 W	12	23 N	42	5	NH	07	992.1	16.2	13.6			23	6 11.5
MV TOYOTA MARU # 10	JAPANESE	17	29.0 N	147.2 W	18	22 N	43	2	NH	03	1006.5	22.0	19.0			22	8 13
SS TRANSCOLORADO	AMERICAN	17	26.8 N	155.1 W	06	20	45	10	NH	02	1004.1	22.2	21.7	5	8	29	< 6 10
SS OREGON MAIL	AMERICAN	18	47.7 N	131.3 W	18	29	43	10	NH	01	989.5	6.1	4.4	3	8	29	8 11.5
SS SANTA MARIA	AMERICAN	18	42.7 N	124.7 W	12	19	30	2	NH	64	1002.4	11.6	14.4	4	11.5	29	8 10
MV HOEGH MALLARD	NORWEGIAN	18	39.0 N	123.3 W	12	16 N	44	10	NH	02	1011.5	12.0	12.0				
SS GALVESTON	AMERICAN	18	53.2 N	135.3 W	18	29	38	1	NH	09	968.8	0.0	8.7			29	6 16.5
SS ARCTIC TOKYO	LIBERIAN	18	44.0 N	147.4 E	12	29 M	48	.25	NH	45	982.0	3.0	7.0	13	10		
MV ASIA ZEBRA	LIBERIAN	18	31.8 N	152.2 E	06	27 N	45	10	NH	03	1002.0	16.0	16.0	8	6.5	26	13 23
MV EASTERN OCEAN	LIBERIAN	18	49.4 N	130.2 W	12	15 N	42	2	NH	60	979.2	7.8	10.8	10	23		
SS LONGVIEW VICTORY	AMERICAN	19	28.1 N	150.0 E	18	28	47	10	NH	02	1012.5	15.5	18.5	9	11.5	28	12 18

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperatures °C Air	Temperatures °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves* Dir. 10°	Swell Waves* Period sec.*	Swell Waves* Height ft.
NORTH PACIFIC OCEAN		JAN.															
MV MARGARET CORD	DANISH	19	32.9 N	141.2 E	06	30	45	10 NM	16	1012.5	6.8	16.0	7	14.5			
SS ARCTIC TOKYO	LIBERIAN	19	47.2 N	169.7 E	06	04 N	48	10 NM	03	977.0	6.3	5.0	10	13			
MV ASIA ZEBRA	LIBERIAN	19	33.4 N	148.2 E	18	32 N	45	9 NM	91	1011.0	8.0	13.0	8	14.5	32	11	26
SS PHIL MAIL	AMERICAN	19	54.2 N	155.0 W	12	28	55	2 NM	85	1002.7	- 2.9	4.4	10	18			
SS GALVESTON	AMERICAN	19	53.5 N	130.7 W	06	23	50	5 NM	02	989.2	2.3	5.5	5	13	27	9	19.5
MV NORRU	NORWEGIAN	20	29.5 N	162.9 E	18	29	45	10 NM	01	999.0	13.6	17.0			29	>13	49
SS LONGVIEW VICTORY	AMERICAN	20	27.4 N	153.0 E	06	28	45	10 NM	02	1011.2	13.5	21.0	9	13	28	>13	18
MARITIME FORTUNE	PANAMANIAN	20	49.2 N	175.7 E	06	05 N	45	2 NM	16	975.5	5.3	6.0	8	10	05	12	13
MV ASIA ZEBRA	LIBERIAN	20	33.5 N	145.5 E	06	32 N	45	10 NM	96	1015.0	7.0	16.0	9	14.5	32	11	29.5
SS ARCTIC TOKYO	LIBERIAN	20	51.7 N	173.3 E	18	08 N	46	1 NM	65	986.0	2.3	4.0	5	5			
SS TRANSCOLORADO	AMERICAN	20	26.8 N	178.7 W	18	23	50	5 NM	50	1000.7	22.2	21.1	7	24.5	29	6	14.5
SS JAPAN BEAR	AMERICAN	21	38.5 N	158.8 W	12	17 N	46	5 NM	03	1004.2	14.4	12.2	8	11.5			
MV SKOUSTAD	NORWEGIAN	21	35.2 N	157.6 E	06	34	42	5 NM	66	1005.5	9.0	13.0					
SS ARCTIC TOKYO	LIBERIAN	21	52.0 N	174.2 E	00	36 N	47	1 NM	82	980.0	2.0	4.0	5	8			
SS ARCTIC TOKYO	LIBERIAN	21	52.9 N	179.8 W	18	08 N	48	1 NM	81	978.0		5.0	7	10.5			
SS TRANSCOLORADO	AMERICAN	21	26.4 N	176.0 W	00	24	50	2 NM	62	1003.4	17.8	21.1	12	24.5			
SS LUNGVIEW VICTORY	AMERICAN	21	26.2 N	161.0 E	12	28	55	10 NM	02	1010.2	17.8	17.8	6	11.5	32	< 6	37.5
SS ARCTIC TOKYO	LIBERIAN	22	53.2 N	178.2 W	00	05 N	48	1 NM	68	976.0		5.0	6	14.5			
SS SINCLAIR TEXAS	AMERICAN	22	48.7 N	134.1 W	18	24	49	1 NM	50	1023.7	14.0	6.0	8	14.5			
MV NORRU	NORWEGIAN	22	29.1 N	156.0 E	18	25	45	10 NM	03	997.0	17.0	17.0	12	24.5	27	>13	29.5
MV MONTIRON	LIBERIAN	22	31.7 N	170.2 E	00	32 N	46	10 NM	64	1000.0	17.0	17.0	7	32.5			
MV NORRU	NORWEGIAN	23	29.1 N	156.5 E	00	27	49	10 NM	01	1000.0	18.0	18.0	12	16.5	27	11	24.5
SS ORIENTAL EXPRESS	LIBERIAN	23	35.4 N	167.6 E	06	31	48	1 NM	52	985.4	10.6	20.0			11	6	16.5
MV MONTIRON	LIBERIAN	23	29.8 N	164.8 E	18	29 N	46	5 NM	03	999.9	18.0	18.0	10	46			
SS SINCLAIR TEXAS	AMERICAN	24	53.4 N	143.1 W	00	22	45	1 NM	50	998.2	4.2	3.9	6	16.5			
SS CALIFORNIA	AMERICAN	24	47.6 N	149.0 W	06	20	45	10 NM	02	1010.8	7.8	6.1	7	16.5			
MV MONTIRON	LIBERIAN	24	30.1 N	164.5 E	00	31 N	41	10 NM	03	1000.7	20.0	19.0	7	32.5			
SS JAPAN BEAR	AMERICAN	24	42.7 N	178.3 E	06	06 N	42	5 NM	63	995.0	5.6	8.3	8	13			
MV VAN ENTERPRISE	LIBERIAN	25	49.5 N	137.5 W	00	27 N	45	5 NM	05	1008.0	8.0	7.0	12	6.5	27	8	19.5
SS PHIL MAIL	AMERICAN	25	37.7 N	145.2 E	06	31	45	5 NM	26	998.6	4.4	8.9	10	24.5	31	10	19.5
SS CALIFORNIA	AMERICAN	25	47.9 N	140.0 W	00	28	48	5 NM	02	1021.7	6.1	5.6	10	14.5			
MV NURRU	NORWEGIAN	25	32.6 N	147.7 E	12	31	45	10 NM	80	1006.0	12.0	13.0			31	X	23
MV WOERMANN SASSANDRA		26	41.4 N	146.2 E	00	32	35	200 VD	85	999.7	- 1.0	5.0	9	19.5			
SS JAPAN BEAR	AMERICAN	27	38.7 N	150.6 E	18	29 N	48	10 NM	27	1000.8	3.9	9.4	10	18			
MV MONTIRON	LIBERIAN	28	32.2 N	143.6 E	06	30 N	42	5 NM	03	1000.9	13.0	17.0	10	26	30	10	29.5
MV VAN ENTERPRISE	LIBERIAN	29	51.8 N	167.4 W	12	07 N	42	5 NM	58	1000.0	5.0	3.0	8	10	07	8	13
SS POLAR ALASKA	LIBERIAN	30	52.1 N	174.1 E	12	07 N	45	1 NM	80	997.0	2.0	3.0	8	6.5			
SS PRES PIERCE	AMERICAN	30	41.6 N	175.0 E	00	23 N	42	5 NM	02	999.7	11.1	12.2	11	11.5			
SS POLAR ALASKA	LIBERIAN	31	53.3 N	178.5 W	12	07 N	45	.5 NM	67	990.0	0.0	0.0	8	8			
SS SINCLAIR TEXAS	AMERICAN	31	53.2 N	141.3 W	06	09	50	5 NM	03	984.8	3.3	3.3	6	21			
MV PACKING	LIBERIAN	31	32.6 N	176.0 E	06	06 N	43	1 NM	71	994.0	3.0	4.0	8	13	06	10	19.5
SS CHEVRON CALIFORNIA	AMERICAN	31	34.7 N	142.8 W	12	07	45	5 NM	21	992.0	0.6	2.2	5	16.5	07	10	24.5
OCEAN STATION VESSELS																	
PACIFIC N																	
USCGC RUSH	AMERICAN	14	30.0 N	140.0 W	21	20 N	30	.25 NM	61	1004.5	20.2	20.1	8	18			
USCGC RUSH	AMERICAN	15	30.0 N	140.0 W	00	21 N	48	.25 NM	83	1000.8	20.0	20.1	8	18			
NORTH PACIFIC OCEAN		FEB.															
SS MOBILE	AMERICAN	1	51.2 N	130.2 W	18	19	42	5 NM	02	977.3	6.7	7.2	8	13			
SS CHEVRON CALIFORNIA	AMERICAN	2	48.6 N	133.6 W	00	22	43	5 NM	50	1014.0	8.3	8.6	9	10	22	10	19.5
MV AIDA	SWEDISH	3	43.7 N	151.6 E	12	31	30	5 NM	03	1009.5	0.0	4.0	10	23	29	>13	23
MV VAN ENTERPRISE	LIBERIAN	3	43.6 N	153.2 E	18	24 N	41	10 NM	70	1004.0	1.0	3.0	10	8	29	8	13
SS POLAR ALASKA	LIBERIAN	3	59.2 N	152.3 W	00	05 N	45	1 NM	86	990.0	7.0	4.0	7	6.5			
MV BEISHU MARU	JAPANESE	3	40.9 N	179.5 E	00	23 N	32	2 NM	02	998.3	11.0	12.5	4	13	22	8	14.5
MV MARITIME ACE	PANAMANIAN	4	53.9 N	156.0 W	18	23 N	46	5 NM	02	996.5	3.0	4.0	10	18			
SS IDAHO STANDARD	AMERICAN	4	39.2 N	158.9 E	00	29	47	5 NM	27	1006.7	7.6	12.8	4	8	29	9	16.5
MV WAY WAY	LIBERIAN	4	34.0 N	168.0 E	12	27 N	45	2 NM	01	1007.6	13.5	10.7			26	8	6.5
MV TOYKO VENTURE	LIBERIAN	5	31.0 N	173.6 E	12	28	30	10 NM	02	1014.5	13.0	18.0			29	8	10
MV WAY WAY	LIBERIAN	5	33.7 N	165.2 E	06	28 N	45	5 NM	80	1011.6	14.8	10.8			29	8	6.5
MV MARITIME ACE	PANAMANIAN	6	52.1 N	167.7 W	06	02 N	46	2 NM	81	980.0	2.0	4.0	12	19.5			
MV HIKI MARU	JAPANESE	6	40.0 N	170.4 W	00	25 N	42	5 NM	02	999.3	11.0	11.0	5	8	23	8	14.5
SS PRES POLK	AMERICAN	6	30.0 N	178.9 E	00	29	44	10 NM	02	1017.4	18.1	17.8	4	11.5	32	6	11.5
MV PERNSTAR	NORWEGIAN	6	42.0 N	172.9 W	06	28	44	10 NM	91	992.0	8.5	11.0	8	19.5			
SS PIONEER COMMANDER	AMERICAN	7	28.1 N	123.4 E	12	01	45	5 NM	50	1020.0	11.2	23.3	5	13	01	7	19.5
MV MEDEA	SWEDISH	8	34.6 N	146.9 E	12	26	46	5 NM	02	979.2	14.0	14.0	10	11.5			
MV MARCONA TRADER	LIBERIAN	8	38.0 N	141.0 E	06	33	46	5 NM	02	990.5	11.5	21.0			33	X	41
MV MONTIRON	LIBERIAN	8	36.3 N	150.5 E	18	25 N	33	5 NM	02	998.4	10.0	1.3	10	32.5			
SS HONGKONG MAIL	AMERICAN	8	41.8 N	145.1 E	18	03	35	1 NM	73	990.9	0.0	4.4	5	16.5	06	8	16.5
MV WAY WAY	LIBERIAN	8	34.4 N	148.5 E	12	27 N	30	1 NM	80	991.6	18.3	11.0			26	8	8
MV PLUTOS	GERMAN	8	35.0 N	145.3 E	06	25	48	2 NM	50	984.3	14.5	17.0	8	10			
MV REGENT CEDAR	PANAMANIAN	8	37.1 N	179.8 W	00	22 N	43	1 NM	10	1009.9	15.8	13.2	13	26			
SS PIONEER COMMANDER	AMERICAN	8	31.5 N	129.0 E	18	34	49	10 NM	02	1022.0	0.1	17.2	5	13	33	7	19.5
MV PAN ASIA	PANAMANIAN	8	39.7 N	175.9 E	00	36 N	30	200 VD	04	999.3	9.0	19.0	8	16.5			
MV GRAND GLOBE	LIBERIAN	8	38.1 N	142.1 E	06	01 N	48	5 NM	17	989.0	7.5	20.0			32	9	16.5
MV ASIA ZEBRA	LIBERIAN	9	32.0 N	159.2 E	18	27 N	46	2 NM	01	996.0	14.0	16.0	8	14.5	27	11	19.5
MV WAY WAY	LIBERIAN	9	34.2 N	144.4 E	06	32 N	45	2 NM	66	997.7	10.1	10.4	6	6.5	32	9	11.5
SS SEALAND GALLOWAY	AMERICAN	9	36.5 N	146.3 E	12	32	45	5 NM	02	999.7	9.8	13.8	6	11.5	34	10	13
MV RUBY	LIBERIAN	9	39.0 N	150.3 E	06	17	43	2 NM	56	984.0	8.0	10.0			17	7	32.5
MV PLUTOS	GERMAN	9	33.2 N	153.6 E	06	26	30	5 NM	28	986.5	11.0	16.2	11	29.5			
SS PRES POLK	AMERICAN	9	32.4 N	151.3 E	06	27	48	2 NM	21	992.6	13.8	17.2	6	16.5			
SS PRES FILLMORE /NEW/	AMERICAN	9	37.5 N	152.1 E	00	24	44	5 NM	02	978.7	10.0	11.1	8	10			
SS EXPORT COURIER	AMERICAN	9	31.8 N	148.9 E	06	28	33	5 NM	18	996.8	10.6	19.7	10	19.5			
MV ORIENTAL DESTINY	LIBERIAN	9	32.1 N	152.7 E	06	27	43	10 NM	02	995.3	13.2	17.8	12	19.5			
MV MEDEA	SWEDISH	9	34.2 N	152.2 E	06	27	42	10 NM	16	989.0	12.2	16.5	13	13			
MV MARITIME ACE	PANAMANIAN	9	50.0 N	161.0 E	18	09 N	30	5 NM	03	999.5	0.5	1.0	10	26	09	>13	28
SS HONGKONG MAIL	AMERICAN	9	41.5 N	147.3 E	12	34	70	5 NM	70	988.2	0.0	7.7			36	11	28
MV MONTIRON	LIBERIAN	9	34.0 N	153.8 E	12	27 N	32	5 NM	27	998.7	8.1	1.3	8	32.5			
SS IDAHO STANDARD	AMERICAN	9	46.0 N	174.2 W	00	29	45	1 NM	73	1010.8	0.7	7.2	5	8	21	7	10
MV CHALMETTE	LIBERIAN	9	38.7 N	146.5 E	12	29	33	2 NM	30	994.4	2.5		5	13	XX	X	29.5
MV ORIENTAL DESTINY	LIBERIAN	10	32.1 N	148.5 E	06	31	42	10 NM	03	1006.4	10.7	17.2	12	19.5			
SS HONGKONG MAIL	AMERICAN	10	41.9 N	149.2 E	00	32	30	1 NM		985.8	- 1.1	2.2	XX	19.5	01	8	19.5
MV MONTIRON	LIBERIAN	10	36.0 N	156.5 E	00	27 N	32	10 NM	03	999.3	10.1	1.3	7	32.5			
MV MARITIME ACE	PANAMANIAN	10	50.0 N	156.9 E	06	05 N	04	.5 NM	86	982.0	- 0.5	1.0			06	>13	29.5
SS KOREAN MAIL	AMERICAN	10	30.3 N	163.9 E	18	09	43	5 NM	70	974.0	1.3	3.3	4	10	13	8	13
SS OAKLAND	AMERICAN	10	13.4 N	94.6 W	06	02	43	5 NM	07	1014.6	21.2	24.3	9	24.5			
MV CHALMETTE	LIBERIAN	10	38.8 N	145.4 E	00	32	48	5 NM	67	1005.3	4.0		5	13	31	6	24.5
SS SEALAND GALLOWAY	AMERICAN	10	36.2 N	151.6 E	00	28	45	2 NM	70	997.0	4.5	13.6	6	11.5	29	10	18

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves†		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		FEB.															
MV RUBY	LIBERIAN	10	39.7 N	157.6 E	06	27	55	2 NM	15	980.0	6.0	11.0			27	7	37.5
SS PRES POLK	AMERICAN	10	33.2 N	147.8 E	06	30	45	2 NM	21	1005.4	7.8	14.2	7	16.5			
MV SKAUSUND	NORWEGIAN	10	49.3 N	168.6 E	06	08	30	.5 NM	75	980.0	2.0	1.0	XX	16.5	09	13	23
MV PLUTOS	GERMAN	10	38.5 N	160.3 E	00	27	45	3 NM	25	994.4	11.5		20	29.5			
SS POLAR ALASKA	LIBERIAN	10	42.1 N	146.5 E	12	32 M	45	2 NM	89	993.0	- 1.0	2.0	7	8			
MV SUECIA	SWEDISH	10	15.6 N	95.0 W	00	36	30	2 NM	32	1014.0	24.0	24.0					
SS KOREAN MAIL	AMERICAN	12	44.9 N	150.5 E	12	25	35	2 NM	22	994.9	- 3.3	1.1			25	6	23
MV MARITIME ACE	PANAMANIAN	13	40.7 N	139.2 E	06	27 M	44	2 NM	89	1012.0	- 1.0	3.0	8	11.5	26	12	23
SS ORIENTAL EXPRESS	LIBERIAN	14	30.1 N	163.1 W	18	26	45	10 NM	02	1007.1	12.7	21.2	4	24.5	28	9	46
MV MUSKAY	NORWEGIAN	14	30.9 N	165.0 E	18	25 M	45	5 NM	02	1008.1	19.5	18.0	11	13	29	11	24.5
SS PRESIDENT MADISON	AMERICAN	14	32.8 N	161.5 E	18	32 M	50	2 NM	81	1005.0	14.5	17.6			30	8	16.5
MV WILKAWA	BRITISH	14	31.5 N	155.5 E	12	29	46	5 NM	18	1011.6	11.0	15.0	7	16.5	29	>13	32.5
MV MARGARET CORD	DANISH	15	48.3 N	144.2 W	00	25	46	2 NM	02	990.0	9.2	5.0	10	19.5			
SS GOLDEN BEAR	AMERICAN	15	33.0 N	173.5 E	12	27 M	48	5 NM	01	1003.8	11.1	15.0			28	6	24.5
SS GALVESTON	AMERICAN	15	53.0 N	135.5 W	12	21	30	2 NM	29	992.1	5.5	6.8	7	10	21	>13	23
MV PLUTOS	GERMAN	15	40.4 N	153.3 W	00	27	41	10 NM	01	1006.6	11.5	11.2	5	6			
SS PRESIDENT MADISON	AMERICAN	15	32.1 N	158.5 E	06	29 M	42	10 NM	02	1013.5	12.7	17.3	8	13	29	9	16.5
SS ARCO PRUDHOE BAY	AMERICAN	16	56.7 N	146.4 W	00	27	45	2 NM	70	994.8	- 3.2	3.3	7	16.5	27	12	23
MV AXEL U	NORWEGIAN	16	50.6 N	179.1 E	12	36	41	2 NM	02	986.0	0.0						
MV AXEL U	NORWEGIAN	16	50.9 N	178.8 W	06	07	35	2 NM	56	980.0	0.0						
MV KINYO MARU	JAPANESE	16	48.7 N	148.6 W	12	20 M	41	5 NM	25	1013.0	8.0	6.0			XX	X	6.5
SS GOLDEN BEAR	AMERICAN	17	38.3 N	161.7 E	06	27 M	41	5 NM	61	1012.1	15.6	14.4	XX	6.5	26	< 6	13
SS PRES ARTHUR	AMERICAN	17	36.5 N	177.6 E	00	23	41	5 NM	03	1007.5	15.6	14.4			23	X	10
SS HAWAIIAN QUEEN	AMERICAN	20	42.6 N	132.6 W	15	10	30	2 NM	85	1001.4	10.0	13.4	6	14.5			
MV GRAND HOLLY	PANAMANIAN	20	39.7 N	177.1 E	00	14	45	1 NM	61	1002.0	16.0	11.5	12	24.5			
SS SUMMIT	AMERICAN	20	55.2 N	160.3 W	18	32	45	2 NM	10	1014.3	-13.2	2.7	4	8			
SS ALASKAN MAIL	AMERICAN	20	54.7 N	149.2 W	12	31	45	5 NM	01	984.8	- 1.2	3.9			31	12	16.5
MV NORTHERLY TRADER	LIBERIAN	20	47.3 N	166.3 E	12	03 M	45	< 50 YD	09	998.0	- 1.0						
MV ASIA BRIGHTNESS	LIBERIAN	20	43.2 N	165.0 E	06	96	65	2 NM	10	999.8	6.0				XX	X	39
SS IDAHO STANDARD	AMERICAN	21	47.2 N	127.4 W	00	17	45	2 NM	21	1004.0	9.0	8.3	6	10	XX	X	11.5
SS NEVADA STANDARD	AMERICAN	21	53.1 N	133.6 W	03	14	60	.25 NM	65	967.5	5.0	6.7			14	11	32.5
GOLDEN EXPLORER	LIBERIAN	21	53.6 N	150.3 W	06	31 M	48	10 NM	02	990.5	- 2.0	4.0	2	14.5	30	< 6	21
SS SUMMIT	AMERICAN	21	53.7 N	157.5 W	06	01	50	5 NM	02	1007.7	-11.3	2.8	9	10	34	9	16
SS ARCO PRUDHOE BAY	AMERICAN	21	59.0 N	151.7 W	00	29	55	200 YD	75	988.6	- 6.6	2.2	8	34.5			
SS ALASKAN MAIL	AMERICAN	21	55.5 N	153.0 W	12	32	45	2 NM	70	994.5	- 6.6	3.3	11	19.5			
SS WASHINGTON MAIL	AMERICAN	21	53.1 N	143.0 W	12	31	45	2 NM	70	982.5	2.2	5.6	6	10	31	12	24.5
MV NORTHERLY TRADER	LIBERIAN	22	43.9 N	157.7 E	00	35 M	49	1 NM	86	999.0	0.0						
MV GRAND HOLLY	PANAMANIAN	22	46.4 N	168.5 W	18	05	41	5 NM	89	1018.0	3.0	6.0	15	19.5	05	12	24.5
USCGC MUNRO	AMERICAN	22	56.3 N	157.3 W	18	27 M	50	2 NM	09	1004.0	- 3.0	1.7	5	11.5			
MV GRAND HOLLY	PANAMANIAN	23	47.0 N	166.5 W	06	05	41	2 NM	02	1025.0	4.0	6.0	12	26	05	>13	29.5
SS ALASKAN MAIL	AMERICAN	23	54.5 N	161.5 W	12	34	50	5 NM	03	1014.0	- 6.6	3.3	8	19.5			
SS ARCO PRUDHOE BAY	AMERICAN	23	49.5 N	135.8 W	06	17	45	.5 NM	65	1011.0	6.0	4.4	6	13	XX	X	11.5
SS WASHINGTON MAIL	AMERICAN	23	53.7 N	161.0 W	18	35	45	5 NM	02	1013.5	- 7.8	3.3	7	16.5	34	10	29.5
USCGC MUNRO	AMERICAN	24	54.8 N	160.2 W	12	31 M	46	5 NM	02	1010.6	- 9.8	2.2	5	8			
SS ARCO PRUDHOE BAY	AMERICAN	24	48.1 N	128.3 W	18	18	45	2 NM	80	1018.9	8.7	7.8	9	16.5			
SS ALASKAN MAIL	AMERICAN	24	54.6 N	164.1 W	12	32	35	> 25 NM	02	1022.0	- 9.4	1.7					
SS STELLA LYKES (NEW)	AMERICAN	25	30.0 N	136.0 E	06	31	45	10 NM	50	1008.0	14.4	18.3			30	6	5
SS AMBA LYNX	AMERICAN	25	14.8 N	96.2 W	18	07	45	10 NM	02	1013.6	26.7	28.7	4	11.5	07	< 6	16
MV LIVERPOOL CLIPPER	BRITISH	25	29.6 N	176.0 E	00	03	45	5 NM	02	1018.3	19.5	19.0	8	19.5	03	10	23
SS EXPORT COMMERCE	AMERICAN	26	10.3 N	97.6 W	18	06	45	> 25 NM	02	1013.5	25.6	27.3	8	24.5			
SS SHELDON LYKES	AMERICAN	26	26.8 N	168.4 E	12	05 M	42	5 NM	80	1015.9	19.4	22.8	12	24.5			
SS PRES PIERCE	AMERICAN	26	13.2 N	95.0 W	12	36 M	50	10 NM	02	1012.4	21.1	28.4	3	18			
SS AMER LYNX	AMERICAN	26	13.9 N	94.4 W	00	35	46	10 NM	02	1012.2	20.6	29.0	8	6.5	01	>13	10
SS EXPORT COMMERCE	AMERICAN	27	10.0 N	98.0 W	00	05	45	> 25 NM	07	1011.0	27.2	27.3	4	16.5	05	6	19.5
SS SHELDON LYKES	AMERICAN	27	26.8 N	170.7 E	00	07 M	42	5 NM	09	1014.6	20.0	22.2	12	24.5			
MV BARTLETT	AMERICAN	27	36.3 N	143.4 W	06	26 M	44	5 NM	50	1006.4	14.4	13.3	5	6.5	XX	X	13
MV MONTIRON	LIBERIAN	28	38.0 N	145.9 W	18	32 M	43	5 NM	03	1000.3	10.0	1.1	12	23			
MV KAREN MAERSK	DANISH	28	43.5 N	123.0 W	00	19	48	2 NM	29	994.0	9.0	10.0			19	12	13

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(W) Tropical storm Wanda

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U.S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Rough Log, North Atlantic Weather

April and May 1974

ROUGH LOG, APRIL 1974--Storm tracks across the eastern United States were near normal for location to slightly above normal in number. Fewer than normal came out of central Canada to the junction over the Great Lakes, and the track was more northerly than the mean up the St. Lawrence River valley. The LOWs originating and moving up the East Coast were normal, with a more northerly component.

The majority of the LOWs tracked over or near Newfoundland and then northeasterly to the southern tip of Greenland and the Denmark Strait. Only one LOW that originated west of 25°W moved east of Iceland intact, and that was after May 1.

Several storms tracked across the Mediterranean Sea, but none were indicated to be severe. There was one ship report for 35-kt winds south of Sicilia.

The pressure pattern west of 30°W was normal in pattern and near normal in pressures. The 1003-mb Icelandic Low was located near its 1007.5-mb climatological position, slightly southeast of Kap Farvel. A major trough extended southwestward over Newfoundland. The Azores High, at 1025 mb, located near 30°N, 46°W, was about 5° west of its climatological 1021-mb position. A 1024-mb High was centered over the Shetland Islands and connected with the Azores High by a saddle or col area. Normally, a tongue of low pressure from the Icelandic Low dominates this area of the Norwegian Sea. The Mediterranean Sea experienced generally lower pressure than normal, with several small Highs and Lows. The predominant feature was a 1010-mb Low centered near Liverno.

The major anomaly was a plus 13 mb centered near the Faeroe Islands. The Azores High produced a plus 4 mb near its center. The negative anomalies were a 9 mb over Ellesmere Island, a 4 mb southeast of Kap Farvel, and a 5 mb over the Ligurian Sea.

The upper-air pattern at 700 mb indicated zonal flow across the eastern United States to 30°W, between 30°N and 50°N. The Low was many miles northwest of the surface Low, over the north magnetic pole near Bathurst Island. A trough stretched southeastward over Baffin Island and the Labrador Sea. The two Highs were stacked nearly vertical with their surface counterparts.

There were no tropical cyclones, and none are expected this early in the year.

This first storm of the month formed over Cape May. It moved northeastward south of Nova Scotia, gradually intensifying. At 0000 on the 4th, the 994-mb LOW was near 43.5°N, 47.5°W. The STEPHANITOR was about 180 mi to the south and found 40-kt gales. Twelve hours later at 1200, the rapidly deepening LOW slowed and turned more northward. The center passed within 60 mi of the ULTRAMAR (fig. 49) and hit her with 55-kt winds and 20-ft seas from the southwest on her westerly heading. The C. P. DISCOVERER passed just north of the center with rapidly shifting winds. At this time, she was fighting 45-kt northerly winds, 16-ft seas, and

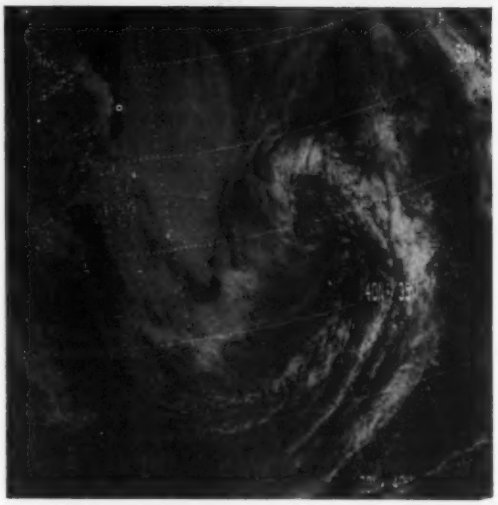

Figure 49.--The ULTRAMAR was just south of the deep center which was located near 44.5°N, 39.5°W, in this 1128 image.

23-ft swells. To the south, near 39°N, 41°W, the BEL HUDSON was sailing with 40-kt winds on her stern.

At 0000 on the 4th, the storm continued to harass shipping. The KHIBINSKIE GORY's weather plot was not clear, but appeared to be 55-kt winds. Gale-force winds were reported as far as 700 mi to the southwest.

The pressure gradient was relaxing on the eastern side of the storm, as it was slowly filling, but remained tight on the western side, at 1200 on the 5th. The TROLL PARK was not aware of this, near 46.8°N, 39.1°W, as she fought 55-kt portside winds with 20-ft swells. Nearby, the ATLANTIC CHAMPAGNE estimated only 40-kt gales, but the seas were running 23 ft. The MUENCHEN, near 43°N, 38°W, or about 300 mi south-southwest of the center, was fighting 45-kt gales, 13-ft seas, and 30-ft swells. Nine hundred miles south of the center, the BREITENSTEIN found a 45-kt isotach.

For the next 48 hr, the LOW drifted slowly northward and almost died out. On the 8th, a new system approached from the southwest, and the point of occlusion of the front moved into the LOW and rejuvenated it.

It was this storm system that combined with and renewed the one above. It formed almost over Cape Hatteras at 0000 on the 6th and moved up the East Coast. The Bermuda High was well entrenched east of Bermuda and blocked easterly movement. As the

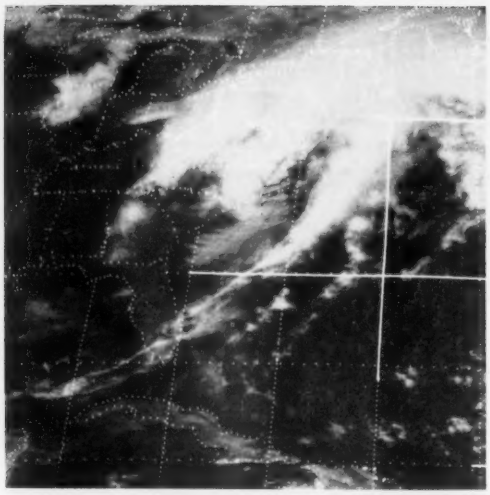

Figure 50. --The storm's center is moving on the coast at 1555. The cold front has passed Ocean Station Vessel "H," and she is being rocked by 50-kt winds.

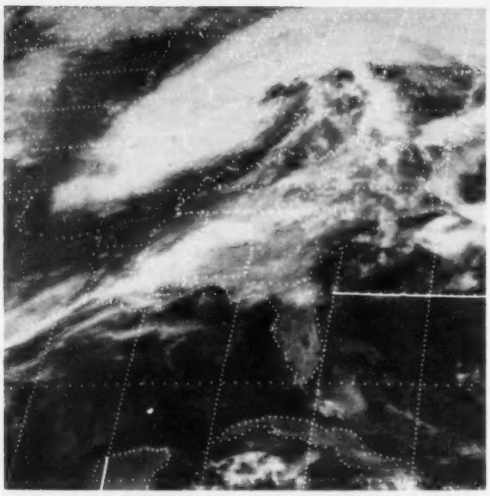

Figure 51. --The clouds have partially cleared behind the front over Lake Erie, but the high winds continued to cause flooding of low areas.

storm approached Nova Scotia, VGBZ was hit by 45-kt gales.

By the time the LOW moved into the Strait of Belle Isle on the 7th, the pressure had dropped to 976 mb. Two ships reported 45-kt gales ahead of the cold front. One was the CETRA COLUMBA.

On the 8th, as the LOW moved up the Labrador Sea, the reports from Ocean Station Vessel "B" were sorely missed, as there were no reports from the 3d until the 15th, when the USCGC CHASE appears to have replaced the DUANE.

It was on the 1200 chart that the occlusion moved into the previous LOW. This resulted in a LOW on each side of Kap Farvel. A 1042-mb HIGH was centered over the northern ice cap. The combined circulation of the two LOWs and the HIGH produced 65-kt hurricane-force winds for Kap Farvel. Narssarssuaq had 45-kt downslope winds from the east-northeast.

The eastern LOW moved up the Denmark Strait and disappeared on the 10th, while the western LOW passed over Resolution Island and dissipated on the 11th.

This storm was manufactured on the Midwest assembly line on the 7th. At 1200 on the 9th, it was over the Chesapeake Bay (fig. 50). It turned northeastward and treated Ocean Station Vessel "H" to 50-kt winds and 21-ft waves. At 1200 on the 10th, the HUDSON was in the Strait of Belle Isle with 35-kt easterly winds. It was snowing heavily, and she reported 9 cm of ice from spray, building rapidly. Ships in the southern quadrant, with 35-kt gales, were having a picnic in comparison. At 1200 on the 11th, the LOW split into two centers, as it passed west of Newfoundland. The drilling rig VGBZ was regaled by 40-kt winds.

At 1200 on the 12th, the LOW split again, as it drove against the ice wedge of southern Greenland. One LOW stalled at Kap Farvel, while the other disappeared into the Denmark Strait.

The middle of the month was relatively quiet, with no storm producing reports more severe than 45 kt.

One of these was a short-lived storm that developed on a front just north of the Azores Islands on the 15th. A day earlier, a LOW had raced northward up the same front, as this one was destined to do.

At 1200 on the 15th, the HANNOVER, on the west side of the LOW, and the MINERAL OUGREE, on the east side, were both hit by 45-kt gales. As the storm moved northward, the MARQUIS and the VORWAERTS reported 35-kt gales. Prior to dissipating on the 17th, it treated another ship to 40-kt gales.

This one was born in the Texas-Oklahoma Panhandle on the 13th, and the center moved across Lakes Michigan and Huron on the 14th (fig. 51). It was an intense storm--992 mb--with many land stations reporting prevailing 30-kt winds. The orientation of the LOW and the winds caused flooding on eastern Lake Erie. Warnings were issued for flooding and beach erosion from Cleveland to Buffalo, as winds gusted to 44 kt. A Canadian station on the north shore of Lake Ontario reported 35-kt prevailing winds at 0600 on the 15th. By late that day, the winds decreased, as the LOW moved up the St. Lawrence River valley.

It crossed the Labrador coast near Mary's Harbour early on the 17th. It had already bestowed 35-kt gales on ships off the coast, while still inland. At 1200 on the 17th, Ocean Station Vessel "B" reported 40-kt gales. As the 982-mb LOW moved eastward across Belle Isle, the DNEPRODZERZHINSK, the FINNAMORE MEADOW, and the IVAN AIVAZOVSKY were treated to 40- and 45-kt gales on the 18th. As the storm moved northward toward Kap Farvel, it weakened and stalled in the Labrador Sea, where it slowly

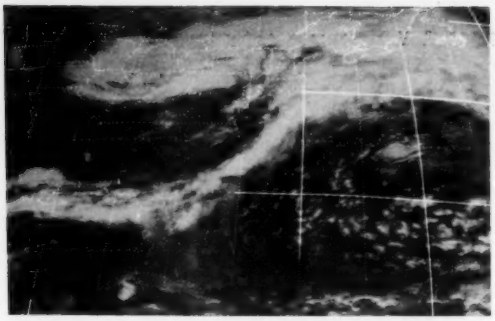

Figure 52.--Cloudy weather prevails, as the strong northerly winds behind the LOW lead to damage, as in figure 53.

circled until the 22d. At that time, it turned sharply eastward and dissipated on the 23d.

An area of very flat gradient existed off the U.S. east coast and southeast early on the 20th. Between 0600 and 1200, a cyclonic circulation developed east of Norfolk. At 0000 on the 21st, the 1005-mb LOW was at 36°N, 58°W. The DAWSON was near 36.5°N, 63.5°W, with 45-kt gales. Earlier, about 1600 on the 20th, the LOW and the DAWSON had crossed paths. The MARQUIS was north of the center, with 35-kt gales and 20ft swells.

On the 22d, the LOW was headed northeastward, and the EDE SOTTORF found 45-kt winds in the southwest quadrant. The USCGC EVERGREEN, north of center near 46°N, 44.5°W, had 40-kt gales.

By 1200 on the 22d, the 984-mb LOW had traveled to 47.5°N, 40.5°W. The AMERICAN ACE, BIOKOVO, BIRKENSTEIN, and the CAST BEAVER surrounded the LOW and radioed 40- to 45-kt gales. This LOW originated further east and passed east of Kap Farvel, but still foundered on the rocks and ice of Greenland's east coast.

This storm, which raised havoc over the Great Lakes, can be traced back to Nevada on the 18th. The LOW moved eastward and, on the 20th, turned northeastward as it pushed against a HIGH over the northeastern United States. Gale warnings were posted for Lakes Michigan and Superior late on the 21st, as the storm approached. The central pressure was about 990 mb as the LOW passed over Lake Superior on the 22d.

As the storm moved eastward across Ontario, strong northerly winds replaced the earlier southerly gales. On the 23d, gale-force winds were blowing across Lake Superior and down Lake Michigan (fig. 52). Waves caused more beach erosion along the eastern shore of Lake Michigan (fig. 53). As the storm continued eastward, gale warnings were posted for Lake Huron on the 24th. Gusty 30- to 35-kt winds were blowing over the lower lakes.

On the 23d, the LOW split into two centers, the new one forming over New Hampshire, while the main LOW continued eastward over Newfoundland. This weakened the gradient, and no gale-force winds were reported by shipping until the 25th. The highest wind

Figure 53.--A wrecked cottage is mute testimony of the high winds and waves that struck the east shore of Lake Michigan. Wide World Photo.

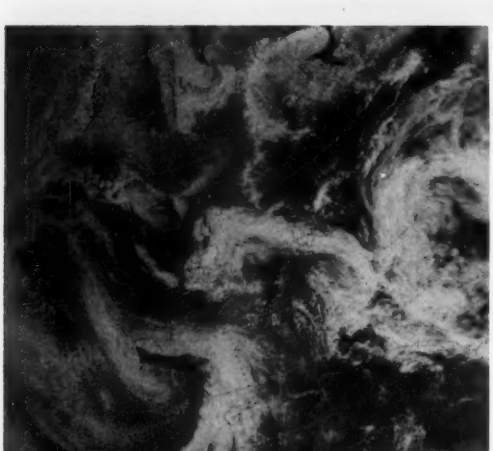

Figure 54. --The frontal cloud pattern has moved into the Bay of Biscay ahead of the LOW.

reported at sea during this storm was 40 kt, by Ocean Station Vessel "I" at 0000 on the 26th. At that time, the LOW was moving northward into the Denmark Strait, where it dissipated on the 27th.

This last storm of the month developed over Ontario on the 29th, but did not cause any grief until May. As it moved over Newfoundland at 1200 on the 30th, it was a weak 1000-mb circulation. As it moved over the warmer water, it started growing. At 1200 on May 1, the JOHANN BLUMENTHAL, near 47.5°N, 33.5°W, was hit by 45-kt gales as she passed about 240 mi south of the center.

On the 2d (fig. 54), the LOW approached the Bay of Biscay, where its eastward movement slowed considerably. The NIENBURG, near 46°N, 19°W, was whipped by 50-kt winds. Further north near 49°N, the ROCKENHEIM was swept by 45-kt winds, as was the ZEEBRUGGE at 44.2°N, 15.1°W. Waves of 15 to 20 ft prevailed over the area. At 0000 on the 3d, 40- to 45-kt winds were blowing, and the waves had built to 25 and 30 ft. At 1200, the CITY OF WORCHESTER, near 46°N, 10°W, was hammered by 50-kt winds and 23-ft seas. A ship reported 33-ft swells off Cabo Finisterre.

On the 4th, the LOW split into three centers. The center that formed over southern Germany became the dominant circulation and moved inland.

Casualties--The 9,171-ton Canadian Laker POINTE NOIRE became stuck in ice on Lake Superior near Blake Point, Isle Royale, on the 4th. On the 8th, arrangements were made to rescue the crew of the British motorvessel MERCURY, aground near Punta Beata, Dominican Republic, by helicopter, because the crew was in danger due to weather conditions. The American EXPORT AGENT (7,849 tons) struck a shore crane at Isbenderum, Turkey, due to a heavy storm on the 29th. On the 25th, the cruise ship ROTTERDAM (37,783 tons) was grounded in a heavy gale in the Bermuda Narrows.

ROUGH LOG, MAY 1974--The number of storms was well above normal, especially over the eastern United States. The two northern primary tracks, across southern central Canada and the Midwest of the United States across the Great Lakes, were normally located, but turned northerly over the St. Lawrence River valley toward Hudson Bay rather than Newfoundland. The storms that affected the North Atlantic and originated over the United States came out of the south and southeastern United States and moved northeastward off the coast.

When over water, the storms usually follow one of two paths, either northward into the Davis Strait or northeastward into the Norwegian Sea near the Faeroe Islands. This month, they headed primarily northeastward, but south of Iceland they curved back northwestward to dissipate south of the Denmark Strait. One storm formed south of Newfoundland, near 38°N, traveled south of the Azores Islands, then across northern Spain and into France.

The climatic mean sea-level pressure chart for May is rather flat, with slightly less than 10-mb pressure difference between the Icelandic Low (1012.3 mb) and the Azores High (1022 mb). The Azores High is the dominant feature, with the 1016-mb isobar stretching like a rhumb line course between Cape May, N. J., and Shannon, Ireland.

This month's mean pressure pattern was more intense, with a 1005-mb Icelandic Low and a 1021-mb Azores High. The 1016-mb isobar had the same curvature and orientation, but was from approximately Miami to Cape Finisterre. Both pressure centers were near their climatological location.

The major anomaly centers were north of 50°N. A negative 8-mb center was near 57°N, 27°W, and a negative 7-mb subcenter was near 52°N, 40°W. The positive centers were even further north--a 9 mb over northern Greenland and an 8 mb north of Frobisher Bay.

As would be expected, the upper-air mean pressure heights closely matched the sea-level pressures, except shifted westward and southwestward. The wind flow at 700 mb (3,000 m/10,000 ft) was mainly zonal between 30°N and 50°N, with a trough line off the U.S. east coast and another off Portugal and northwest Africa.

There were no tropical storms. Historically, one tropical storm may occur every 5 yr, and only once in 21 yr does it reach hurricane intensity.

Early on the 3d, a wave formed west of Norfolk. It moved northeastward up the East Coast and, by 0000 on the 5th, was near Sable Island. The LASH TURKIYE, at 40.5°N, 61.4°W, was headed into 40-kt gales, with 16-ft seas and 20-ft swells. The LOW, at about 985 mb, continued northeastward, creating only minimum gale-force winds. From midday on the 6th until midday on the 7th, the 976-mb LOW stalled near 54°N, 41°W, while it consolidated its circulation. Funneling and downslope probably contributed to the 45-kt gales at Kap Farvel, while the next weather station northward on the east coast reported calm winds. A ship reported 35-kt gales near the center of the LOW. At 0000 on the 7th, Kap Farvel was receiving 55-kt winds,

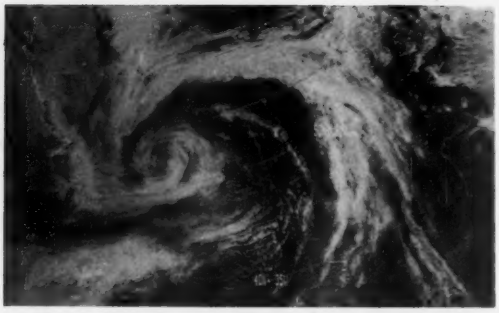

Figure 55. --This storm looks like it should contain high winds, with its circular funnel appearance.

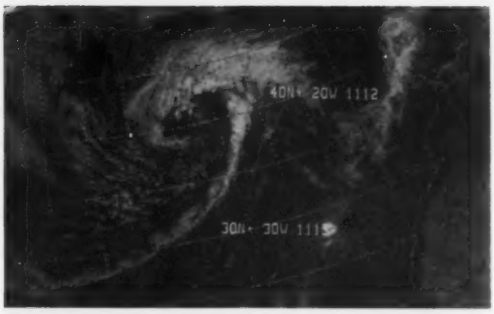

Figure 56. --The satellite passed almost directly over the storm and the TOYOTA MARU, under partly cloudy skies, at 1112.

which became 50 kt at 1200. At that time, the DART AMERICA, near 48.5°N, 40°W, was beaten by 45-kt winds off her bow (fig. 55).

Late on the 7th, the storm started moving eastward, with 35-kt gales in the southern quadrant. The ELSFLETH, TRADER, and Ocean Station Vessel "K" all had 35-kt gales on the 8th and 9th. At 1200 on the 9th, the ATLANTIC FOREST reported 45-kt gales south of the center, near 46.5°N, 13.5°W, and the ZAWIERCIE reported 40-kt gales west of the center near 49°N, 26°W.

On the 10th, the 980-mb LOW turned northward over the west coast of Ireland, and the FORT TRINITE, KAKO MARU, and the POSSEHL reported 40- to 45-kt gales. The seas were running about 16 ft, but the KAKO MARU was plowing into 46-ft swells at only 5 kt.

On the 11th, the LOW was moving northwestward, south of Iceland, and weakening. On the 12th, it was absorbed by another, approaching from the west.

Some background--a LOW moved off Cape Hatteras on the 6th and northeastward up the East Coast. A small HIGH was east of the LOW and moving eastward and building. By the 8th, it had combined with the Azores High at 1030 mb and spread westward. This blocked the front in the vicinity of Bermuda, and waves were forming and moving northeastward on the front.

On the 9th, one of these developed more energy and, by 1200, was a 1010-mb LOW. At the same time, another LOW had formed over Cuba and was racing up the front. Late on the 11th, the two joined forces. Winds of 35 kt were blowing north of the center on the 11th, but quieted, at least as far as reports were concerned, on the 12th.

At 1200 on the 13th (fig. 56), the 986-mb LOW was at 42°N, 33°W, having pushed the HIGH southward and worn down its pressure to 1023 mb. The TOYOTA MARU No. 11, about 150 mi south of the center, was headed toward the Panama Canal at 5 kt, into 50-kt storm winds and 26-ft swells. North of the center, about 100 mi, the KAKO MARU was making 15 kt in the same direction, with 40-kt gales and 16-ft swells on her stern. Twelve hours later, the TOYOTA was still on the receiving end of 35-kt gales on her starboard side.

The LOW was now turning northward, with only minimum gale winds. On the 16th, the LOW had turned toward the northwest, and Ocean Station Vessels "I" and "J" reported 35-kt gales, with "A" having 40-kt gales. "I" also suffered 25-ft swells from the southeast. On the 17th, as the LOW stalled near 59°N, 31°W, the HINRIK, at 64.5°N, 35°W, came in with 45-kt gales. By the 18th, the LOW had been absorbed by another system.

During the third week of the month, the Azores-Bermuda High built not so much in pressure, but in area. On the 18th, there was a 1025-mb center over Bermuda, and the 1020-mb isobar circled 30°N from coast to coast. On the 19th, this HIGH was building eastward, and an elongated center formed off the Iberian Peninsula. This effectively blocked the eastward movement of LOWs, resulting in northerly and northeasterly paths. The LOWs also did not develop large circulations and tight gradients for high winds. This situation, called a "blocking High," continued through the 27th, with a maximum pressure of 1039 mb centered near 45°N, 20°W, on the 23d (fig. 57).

When the major high-pressure center moved northward off the Bay of Biscay, low-pressure centers attempted to move to the south. A LOW developed off Morocco and pushed westward, while various LOWs pushed eastward. Finally, on the 26th, a LOW pushed through, separating the misplaced Azores High and the Bermuda High. This LOW moved across northern Spain into France and Germany. This was the only LOW to travel from the western ocean into continental Europe this month. There were no significant winds reported with the low-pressure system, except a 40-kt report by the CASSIOPEE on the 29th, near 34°N, 14°W.

This LOW developed over Georgia on the 26th. At 1200 on the 27th, it was 1002 mb over Cape Hatteras and moving northeastward. On the 28th, a ship, at 39°N, 71°W, reported 40-kt gales. At 1200, the JAPAN CEDAR was banged by 45-kt winds, southwest of the center, and the KATJA had 40-kt southerly winds ahead of the front, southeast of the center. At 0000 on the 29th, three ships reported 40-kt gales, two off Nova Scotia and one southeast of the center, near 40.5°N, 56°W. Two of them were the ALERT

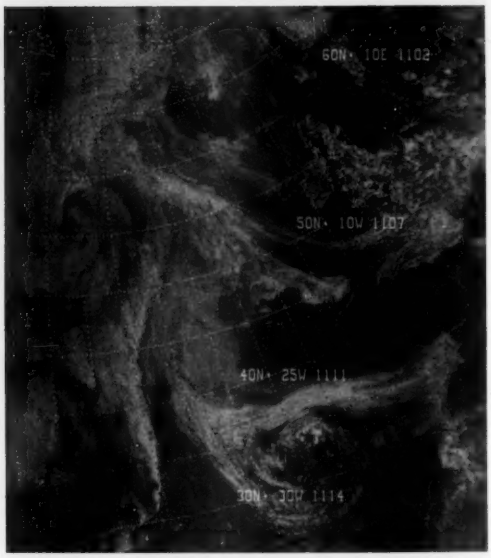

Figure 57.--The relatively clear area northward off the coast of Portugal is the position of the blocking HIGH. The LOWs that combined south of the HIGH can be seen near 34°N, 24°W, and 40°N, 52°W. A LOW that had been forced northward up the west side of the HIGH is positioned near 56°N, 46°W.

and the IMPERIAL QUEBEC.

A very significant report was sent by the LEVERKOSEN from near 48.5°N, 49°W. It contained the remark "Icebergs."

At 1200 on the 29th, the 984-mb LOW was at 46°N, 58°W (fig. 58). About 300 mi south, the BIRTE HUGO STINNES was hammered by 50-kt winds, thundershowers, and 23-ft seas and swells. Forty-knot winds were still blowing off Nova Scotia. At 0000 on the 29th,

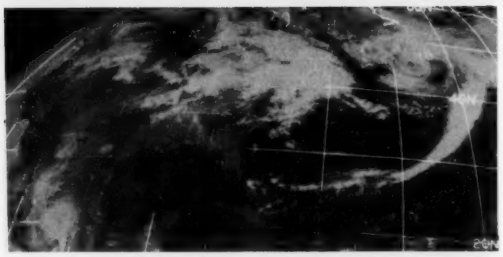

Figure 58.--This image, on the afternoon of the 29th, shows the LOW off Nova Scotia and, far to the southwest, tropical storm Aletta over Mexico.

the FRIDA DAN also had 50-kt winds, near 41°N, 59.5°W, and the BIRTE HUGO STINNES still had 45-kt gales.

As the LOW moved past Newfoundland, it weakened, but, on the 31st, still generated 40-kt gales for the USCHIT. On June 1 and 2, the LOW moved southward and eastward of a stationary LOW near Iceland. Late on the 2d, the two combined.

Casualties--The 290-ton SAN SALVADOR EXPRESS was disabled 60 mi southeast of Nassau. The vessel ran aground and began breaking up in rough seas. Helicopters rescued 49 passengers and 6 crewmen on the 12th. On the 12th, a tornado touched down near Commodore's Point Terminal in Jacksonville, Fla., causing heavy damage to two warehouses and cargo.

The 11,682-ton Liberian tanker MELITI, Algiers to New York, stopped at Freeport, Bahamas, on the 18th, with heavy weather damage to the forecastle, which was set down approximately 8 in.

The Canadian IMPERIAL ACADIA (7,068 tons) was reported in heavy ice on the 21st, with a punctured bow and bow thruster room flooded.

In the Panama Canal, the Italian containership MEDITERRANEAN (26,500 tons) and the Belgian carrier TITUS (22,721 tons) collided during a violent rainstorm.

Rough Log, North Pacific Weather

April and May 1974

ROUGH LOG, APRIL 1974--The North Pacific was near normal this month. The storm tracks followed the climatological pattern very well and were normal in number. There were two primary sources of storms, one across the southern Sea of Okhotsk and the other south of Japan. The tracks joined south of the Near Islands and paralleled the Aleutian Islands into Bristol Bay and the Gulf of Alaska. A secondary track came out of the midocean north of Hawaii and into the Gulf of Alaska.

The mean sea-level pressure pattern was normal, but more intense. The 1009-mb Aleutian Low, which climatologically has several subcenters from Kamchatka to Bristol Bay, had two subcenters--1002 and 1003 mb--but without the subcenter near Kamchatka. The Pacific High also had several centers and was 2 to 4 mb higher in pressure. The eastern center was about 20° longitude further east along 140°W.

The anomaly centers clearly indicated the difference from the climatic mean. The ocean north of 40°N, except from Vancouver Island south along the North America coast, was basically negative. A negative 8-mb center was located south of Umnak Island. A positive 7-mb anomaly was centered near 35°N, 135°W, and positive 3 mb near 30°N, 175°E.

The upper-air pattern was mainly zonal flow around a Low over the Bering Sea, with two trough lines, one over the Asian east coast and the other through the Gulf of Alaska along the West Coast. A ridge extended from the northern Rocky Mountains across Alaska to a High over the East Siberian Sea.

Tropical storm Babe, in the western Pacific, was

the only tropical cyclone.

The storms this month were less severe than in the previous winter months, but about the same as last year during April. There was no large LOW that developed and dominated a major part of the ocean, where exceptionally high winds and seas can be generated.

The first significant LOW came into being in a trough extending out of a LOW in the Gulf of Alaska on the 3d. It was first discovered on the weather charts near 40°N, 164°W, at 0000. It swung southeastward, but, by 0000 on the 4th, it was headed northeastward, at 1006 mb, near 38°N, 150°W. The TOSCA and UNION SUNRISE were both headed westward south of the center. On the backside of the LOW, they encountered 45-kt gales from the northwest. The center continued on a northeasterly track toward Vancouver Island. There were no reports in the vicinity at 1200 on the 4th. At 0000 on the 5th, the PRESIDENT GRANT bucked 35-kt gales about 500 mi to the southwest of the center, and the USCGC WINONA, 600 mi to the south, fought 40-kt gales and 18-ft seas.

By 1200 on the 5th, the 977-mb LOW was approaching the West Coast. The WINONA had 30-kt gales off her portside, and the WASHINGTON MAIL, just a few miles away at 37.3°N, 136.6°W, had 35-kt gales, 12-ft seas, and giant 36-ft swells on her bow. Near the coast, the LOW turned northward to pass near the Queen Charlotte Islands on the 6th. The MONTIRON found 45-kt gales about 200 mi south of the center. Land stations on Vancouver and Queen Charlotte Islands reported 35- to 40-kt gales. By the 7th, the LOW had beat itself out on the rugged coast, as other LOWs moved in to replace it.

An elongated north-south trough was situated over the Sea of Okhotsk on the 5th. A weak, diffuse LOW had moved out of Manchuria on the 3d and combined with this trough to intensify it. By 1200, a 998-mb LOW, with a well-developed circulation, was present. The center moved slowly up the Kuril Islands. At 1200 on the 6th, the 982-mb center was near 47°N, 155°E. The weather station on Ostrov Iturup measured 50-kt northwesterly gales.

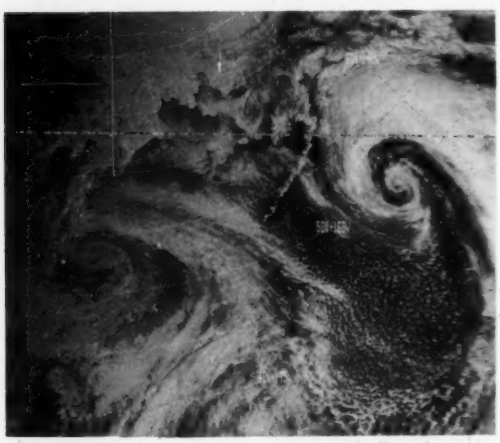

Figure 59.--The eye of the monster is located near 50°N, 150°W, late on the 12th. The knights in shining armor (SHIPS) were able to survive its deadly onslaught.

The surface LOW was located almost directly under an upper-air LOW which was moving around the major long wave pattern as the wave length was making an adjustment. At 0000 on the 7th, the LOW was at 47.5°N, 160°E. South of the center, in a band between approximately 38°N to 45°N, there was an almost straight westerly flow for 1,200 mi. The BEN LOMOND and YONEKAWA MARU were hit by 45-kt gales in this band. The seas were running about 10 ft and the swells up to 23 ft. Northwest of the center, Ostrov Paramushir reported a howling 70-kt wind.

The LOW continued to move eastward at about 25 kt until the 9th, when its upper-air circulation combined with the major upper-air LOW. During this period, only gales of 35 to 40 kt were reported. On the 10th, the surface LOW moved eastward away from its upper-air support and began weakening as it entered the Gulf of Alaska. Just prior to grounding on the Alaska coast near Valdez, it took a last 40-kt swipe at a ship.

Monster of the Month--A weak stationary front lay between the previous LOW and the Pacific High. Near midocean, 36°N, 175°W, a wave formed at 0600 on the 10th. It moved eastward fairly slowly and, at 1200 on the 11th, after passing the THOMAS E. CUFFE, treated her to 35-kt gales. By 0000 on the 12th, the LOW was gaining strength and had a central pressure of 994 mb near 43.5°N, 155°W. The TOYOTA MARU No. 10 was hit by 35-kt gales.

As the storm moved northward into the Gulf of Alaska (fig. 59) it continued to strengthen. At 0000 on the 13th, it was a 972-mb monster near 52°N, 150°W. The ASIA FLAMINGO was in the northwest quadrant near 54°N, 155°W, and was battered by 60-kt winds. Gale winds were blowing all around the center. Some of the reports were from the GOLDEN LIGHT, which reported 26-ft swells, Ocean Station Vessel "P," WORLD PRIDE, and the YONEKAWA MARU. Twenty-four hours later, the WORLD PRIDE still suffered with 45-kt gales, and the WORLD SUPREME fought 40-kt winds. The LOW was now over Kodiak Island and rapidly dissipating. It had completely disappeared by 0000 on the 15th.

This LOW came out of mainland China via the Yellow Sea and Sea of Japan. By 1200 on the 14th, it was moving up the Kuril Islands, a full-blown storm at 984 mb. West of the storm, the ALASKA MARU and the SOYO MARU both found 35-kt gales. At 1200 on the 15th, Ostrov Urup suffered with below-freezing 55-kt winds. The VAN TRIUMPH and WAKAGISAN MARU, in the southern half of the circulation, had 35-kt gales. At 1200, the CHUETSUSAN MARU, 400 mi south of the center, was sailing with 45-kt gales. About 0300 on the 16th, the center crossed the Aleutian Islands near the Near Islands and into the Bering Sea at about 980 mb.

At 0000 on the 17th, the LOW was near 55.5°N, 171°W, and the SOVETSKOE ZAPOLYARYE was cruising into cold 40-kt gales, with snow. Early on

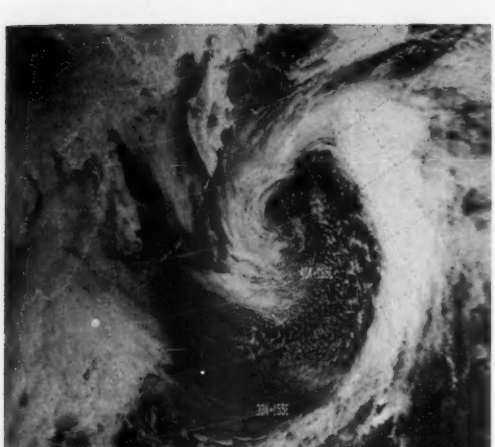

Figure 60. --A specific center is not readily apparent in the cloud pattern late on the 20th. The snow-covered Kamchatka Peninsula is a stark feature. Sea ice is visible in the Bering Strait and along Sakhalin Island.

the 18th, the LOW moved inland over Alaska at Kuskokwim Bay.

Cyclogenesis occurred between two HIGHs over the Sea of Japan on the 18th. The fledgling moved across Hokkaido and, by 1200 on the 19th, was a 994-mb storm. On the 20th, the SHIN HONSHU MARU was hit by 40-kt gales. At 0000, 24 hr later (fig. 60), on the 21st, the storm was 984 mb and had a wide area of circulation. Forty- to 45-kt winds were blowing all around the center, reported by the CANADA MARU, ELIZABETH LYKES, HANETIA, KETCHIKAN MARU,

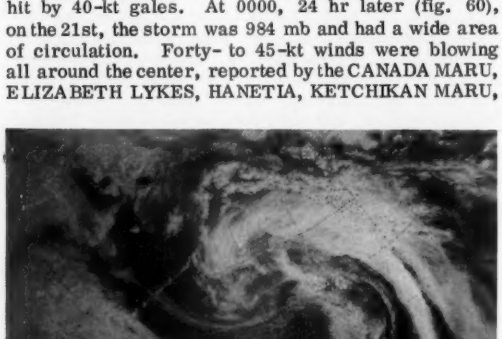

Figure 61. --The two LOWs have combined, and the storm has stalled against the coastal mountains. There appear to be "leads" in the sea ice off Point Barrow.

and the VERRAZANO MARU.

As the storm moved south of the Aleutian Islands late on the 21st, a second center formed north of the islands. The new center started taking over as the major system and was the dominant storm by the 23d, as it moved into the Bering Strait on the 24th.

This last storm of the month was relatively short-lived and traveled only a short distance. It formed early on the 28th, off the U. S. Pacific Coast near 45°N, 149°W. As it moved northeastward, it passed almost directly over Ocean Station Vessel "P" at 1800 on the 28th. Another small LOW was following close behind. On the 29th (fig. 61), the isobars appeared to ground on the southern Alaska coast, and the center stalled near 54.5°N, 147°W. The J. H. TUTTLE, at 55°N, 150°W, found 35-kt winds. By 0000 on the 30th, the two LOWs combined into a 992-mb center, and PAPA's wind increased to 35 kt. Twelve hours later, they further increased to 50 kt. The winds continued to blow and were still 40 kt on May 1 for Ocean Station Vessel "P" and the YONEKAWA MARU, as the storm turned southeastward. On the 2d, it moved into the Strait of Juan de Fuca.

Tropical storm Babe was tracked for several days as a tropical wave from the Caroline Islands in late April. It took another few days to intensify from a tropical depression to a tropical storm, which she did about 300 mi north of Guam on the 29th. By this time, however, it was apparent that Babe was in the process of recurving. Her peak intensity (fig. 62) occurred on the 30th, when maximum sustained winds near her center reached 55 kt and gales extended out some 125 mi in all directions. By late the following day, the weakening, accelerating storm had turned extra-tropical as she crossed the 30th parallel near 152°E.

Casualties--The 12,593-ton GLYFADA SUMMER arrived Kawasaki about the 7th, with heavy weather damage. The 8,433-ton Liberian steamer VALL SUN dragged anchor in Pusan Harbor and drifted into a collision with the 2,766-ton Panamanian NORTHERN STAR and a wharf.

A 284-ton tuna fishing boat, No. 11 SHOEI MARU, overturned and sank after a collision with the 11,144-ton OCEAN SOVEREIGN. Fourteen crewmen were feared trapped in the overturned boat, which sank before rescuers, who were hampered by high waves, could reach them.

Figure 62. --Tropical storm Babe at almost peak intensity, at 2348 on the 29th.

ROUGH LOG, MAY 1974--The number of cyclones were above normal, and they tended to be small and not intense, with large circulations. The overall pattern of their tracks was near normal, but there were significant displacements. The primary track across the Sea of Okhotsk was normally located, but the primary climatological track south of Japan was located further north, across the Yellow Sea and Sea of Japan. More storms tracked into the Bering Sea than normal. This resulted in fewer storms moving eastward, south of the Aleutian Islands and into the Gulf of Alaska, where the storm tracks were further south than the climatic mean.

The sea-level pressure pattern closely matched the climatological pattern. The Aleutian Low, at 1004 mb, was near its 1008.5-mb climatic position of 55°N, 180°. The Pacific High occupied the greatest expanse of the area and was centered on about 35°N. The major center was 4-mb higher in pressure, at 1026 mb, than the 1022.2-mb climatological center and 10° longitude further to the east, near 35°N, 140°W.

The anomalies were relatively small, but they help in understanding the displacement of the tracks. There was a small negative 4-mb center collocated with the Aleutian Low. There were three positive centers of some importance--a 6 mb near 40°N, 130°W, which affected the U. S. west coast; a 4-mb center near 40°N, 155°E, off Japan; and a 4-mb center over the East Siberian Sea.

The upper-air Low at 700 mb was stacked nearly vertical with the sea-level Low and slightly lower than the climatological mean. There were two other negative anomalies, both of which were greater than the one connected with the primary Low. One was located over the Queen Charlotte Islands, and the other, slightly east of the tip of the Kamchatka Peninsula. Since these were not reflected at sea level, they could help explain the slight shift in storm tracks. As normal, the main flow was zonal, centered on about 40°N.

There were two tropical cyclones, one in the eastern and one in the western Pacific. They were tropical storm Aletta and typhoon Carla.

This first storm of the month was over the Sea of Japan on the 1st. It moved eastward with extratropical Babe (fig. 63), approaching from the southwest. At 1200 on the 2d, the 994-mb LOW was near 45.5°N, 157.5°E. The remnants of Babe were near 35.5°N, 159.5°E. The BEISHU MARU was near 41°N, 154°E, and reported 40-kt gales. The LOW moved northeastward on the 3d and then eastward along the Aleutians on the 4th, at 980-mb pressure. By 1200 on the 4th, Babe no longer existed. Two ships, the FORTUNSTAR and LONG LINES, reported 35-kt gales south of the center.

At 0000 on the 5th, the LOW was centered near 50°N, 173°W. The EAST RIVER, at 43.4°N, 174.6°W, was buffeted by 45-kt gales. Further to the southwest, three ships reported 40-kt gales. They were the EMMA JOHANNA, with 26-ft swells, the OIGAWA MARU, and the PHILLIPS OKLAHOMA. Twelve hours later, the EAST RIVER still had 45-kt gales, and the swells had built to 26 ft. On the 6th and 7th, the LOW raced into the Gulf of Alaska, where it filled rapidly.

Figure 63. --Late on the 1st, the storm was near 45°N, 150°E. Extratropical Babe was to the south near 32°N, 152°E, and the beginning of Carla was near 12°N, 148°E.

This storm formed as a diffuse LOW over Mongolia on the 1st. By the 2d, frontogenesis had occurred as it moved across Manchuria. On the 5th, it moved across the Kuril Islands, and a ship reported 40-kt gales. On the 6th, the storm deepened rapidly and was 962 mb over Agattu Island at 0000 on the 7th. At that time, the HAKUHO MARU was fighting 45-kt winds and 26-ft seas near 46°N, 167.5°E, while the GOLDEN EXPLORER, HOYO MARU, and the SHOZUI MARU were contending with 40-kt gales and seas and swells up to 20 ft.

The LOW continued deepening to 956-mb at 1200 on the 7th, over the Bering Sea, but, 12 hr later, the cold water started weakening it. South of the Aleutian Islands, ships were reporting gale-force winds as far south as 43°N. The SHOKAI MARU, at 51.5°N, 153.5°W, east of the front, had 40-kt southerly winds.

On the 8th, the LOW turned north and northwestward and stalled for 48 hr near 59°N, 175°W, while it slowly disintegrated.

Monster of the Month--A 998-mb wave formed over the Sea of Okhotsk on a weak cold front on the 9th. Another LOW was near Nagoya, Japan, and moving northeastward. By 1200 on the 10th, the two circulations had combined into a 987-mb LOW near 48°N, 160°E. The highest winds were in the warm sector, near the warm front. The YAMASHIN MARU, at 39°N, 166°E, had 45-kt southerly winds on her starboard side. The LOW was deepening as it moved northeastward into the Bering Sea near Agattu Island, as

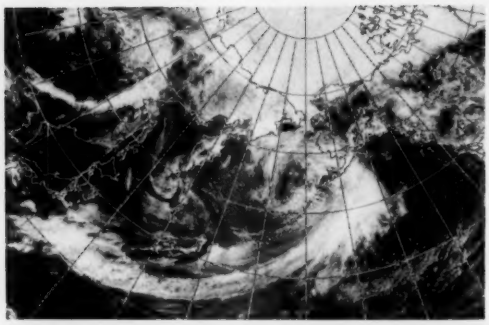

Figure 64. --At 2100 on the 11th, the LOW is near its lowest pressure and strongest winds, while over the Bering Sea.

the previous storm had done. The ASHBY MARU, near 44°N, 175°E, had 45-kt winds with the passage of the cold front.

At 1200 on the 11th, the SHIN HONSHU MARU was near 50°N, 180°, just south of Amchitka Island, and fighting 50-kt storm winds with 23-ft seas and swells. At 0000 on the 12th (fig. 64), the LOW reached its lowest pressure of 961 mb, near 54.5°N, 173°W, where it turned eastward to parallel 55°N. The MIDAS RHEIN was at 48.5°N, 172°W, with 55-kt winds and 23-ft swells on her stern. Not far to the north, the IRISH STARDUST was being washed by 45-kt gales near 51°N, 170°W. This was the largest LOW that transited the North Pacific this month. The 40-kt wind band, about 400 to 600 mi southwest of the center, was outlined by the BARON ARDROSSAN, SHINTO MARU, and the SHINYO MARU on the 13th. The highest sea and swells were 23 ft. That day, the LOW entered the Gulf of Alaska, and, by the 15th, the pressure had risen to over 1000 mb. The LOW turned southeastward and tracked down the coast, where it dissipated on the 16th. Early that day, the MARGARET CORD was banged by 45-kt gales, but these were associated more with a HIGH moving toward the coast than with the LOW.

This cyclone had its origin near Ostrov Urup on the 16th. It formed in a trough at the occlusion point of a front. The MAMMOTH FIR was at 51°N, 164°E, and found 50-kt winds. The LOW moved northeastward up the island chain and, at 0000 on the 17th (fig. 65), was over the tip of the Kamchatka Peninsula. The HOTAKA MARU was near 49°N, 160°E, with 35-kt gales. As the LOW crossed over into the open water, it started to fill, and, by the 19th, had disappeared.

This LOW started out as an easterly wave, and, with a little help, it could have been a typhoon. On the 15th and 16th, there was only a wave, but, at 1200 on the 16th, there were indications of a closed circulation. At 0000 on the 17th (fig. 65), there were two ship reports from the area, and the center was analyzed near 24°N, 174°E, at 990 mb. The GUAM BEAR was near 25°N, 175°E, and reported roaring 65-kt winds. To the northwest, the HAGOROMO MARU was near 26°N, 172.5°E, with 50-kt winds.

Figure 65. --There are three storms on this picture. The one over the Kamchatka Peninsula, the almost tropical LOW, and another not described near 47°N, 172°W.

Wind and pressure reports from ships on the 18th indicated the LOW was moving northward. None were close to the center or previous area of high winds. As the LOW moved northward, it started to fill, and the area of circulation decreased. By the 21st, only a cold trough was left.

There were several LOWs that moved over the northern waters, but none that generated significant weather during the remainder of the month. The main features were two large HIGHs, one over the central ocean and one off the California coast. These effectively blocked development of any strong storms.

Tropical storm Aletta was first detected by satellite late on the 27th near 15°N, 100°W. Maximum winds were 35 kt close to the small storm's center. Aletta intensified and moved toward the northwest at 6 kt. On the 28th, maximum sustained winds reached 50 kt as Aletta paralleled the Mexican coast (fig. 66). However, the following day, she turned northeastward and moved inland near Manzanillo. Once inland, Aletta dissipated.

Figure 66. --Tropical storm Aletta does not show very bright, as she parallels the coast with 50-kt winds.

Typhoon Carla formed in the wake of tropical storm Babe, about 5 days behind her. She followed almost the exact path. However, Carla was much better developed--where Babe was a depression, Carla was a tropical storm. Where Babe was a tropical storm, Carla was a typhoon. Carla passed Saipan on the 2d as a tropical storm. By the 4th, she was a typhoon (fig. 67). She reached a peak early on the 5th, when maximum sustained winds climbed to 85 kt near her center, which had just crossed the 20th parallel near 144°E. The THOMAS B. KIMBALL encountered southeasterly 40-kt winds at this time, some 180 mi northeast of Carla's center. Carla accelerated northeastward and weakened as cold air entered her system. Late on the 6th, she turned extratropical as she crossed the 30th parallel near 154°E.

Casualties--Since the storms were few and weak, there were no weather casualties that came to our attention. It was noted that the 9,646-ton Cypriot GEORGIOS T. was disabled with engine damage in some heavy weather on the 19th, on the way to Vancouver. The tug ARTHUR FOSS was engaged to tow the vessel.

An item of interest--Australian Air Force helicopters braved gale-force winds on the 26th to rescue 33 crewmen from the Norwegian freighter SYGNA (52,950 tons). The ship went aground off Newcastle, New South Wales, and broke in two. As it continued to break up, the crewmen were rescued. Earlier attempts at rescue failed because of high surf and 70-kt winds.

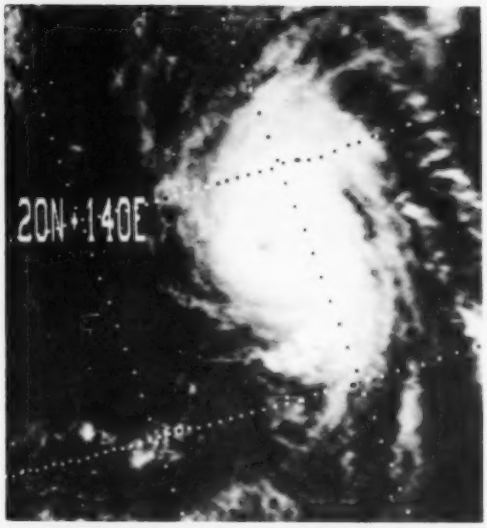

Figure 67.--Typhoon Carla, near her peak at 2352 on the 4th. She was a small storm, but contained sustained 85-kt winds.

Marine Weather Diary

NORTH ATLANTIC, AUGUST

WEATHER. The favorable weather that is characteristic of July generally continues into August, the warmest month of the year over the North Atlantic. The monthly pressure analysis shows the 1022-mb subtropical High centered near 35°N, 43°W, while the Icelandic Low, a broad flat east-west trough, reaches its lowest pressure (1009 mb) over Hudson Strait.

WINDS. Prevailing wind directions conform rather closely with those of the preceding month. North of 40°N, winds are slightly more variable than in July and westerly components generally dominate. The prevailing winds over the North Sea are now from the westerly quarter of the compass. Between 40° and 25°N, the prevailing direction is from the north and northeast in the extreme eastern Atlantic and from the south and southwest in the western ocean. The northwest etesians blow over the Mediterranean Sea and are quite steady over the eastern half. The "northeast trades" of the Atlantic Ocean lie principally between 25° and about 15°N, extending southward to near 10° N over the western half of the ocean. Near the approaches to the United States at these latitudes, the trades become more easterly--the Gulf of Mexico has prevailing easterly winds. Southeasterlies are dominant near the Equator between South America and Africa. Wind speeds on the North Atlantic in August average slightly more than force 3, with lower speeds over the western Mediterranean, the Davis Strait, and the Gulf of Mexico.

GALES. Winds of gale force, except in tropical cyclones, are very infrequent south of 52° N. North of this latitude, gale frequencies of about 5 percent are fairly common, with maximum frequencies of 10 percent or more over the Norwegian Sea and the waters south and west of southern Greenland.

EXTRATROPICAL CYCLONES. A few moderately strong summer LOWS move about north of 40° N. Storms that attain severe intensities during August are usually of tropical origin. Primary storm tracks for extratropical cyclones are from Hudson Bay to Davis Strait and from east of the James Bay region and the eastern Grand Bank to just south of Iceland and then eastward through southern Scandinavia. A secondary storm track crosses eastern Lake Superior before joining the primary track over central Quebec.

TROPICAL CYCLONES. August is one of the principal months in the North Atlantic hurricane season, ranking second behind September in tropical storm development and also in the number of these storms that attain hurricane force. From 1931-73, 103 tropical storms have originated in August, and 66 of these have reached hurricane intensity. A maximum of seven cyclones occurred in August 1933; and, in contrast, no storms were reported during 1941 and 1961. In general, the level of tropical cyclone activity increases as August

advances, with the likelihood of storm occurrence being more than twice as great in the last 10 days as during the first decade of the month. The spawning area of tropical cyclones is much larger in August than during the preceding month. Some tropical cyclones originate as disturbances over southwestern portions of the "African Bulge," intensify into tropical depressions southwest of the Cape Verde Islands, gather strength as they are carried across the lower latitudes of the North Atlantic by the prevailing easterlies, and then enter the Caribbean, Gulf of Mexico, Florida, or the western Atlantic as fully developed hurricanes. A characteristic of this activity is the split mean storm track around the Bahamas with one branch passing to the north of the islands, where it recurves off Cape Hatteras, and the other over the southern portion of the island chain.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time over a portion of the northern ocean south of southern Greenland and several hundred miles southwest of Iceland. Two other areas are also observed. One lies west of the British Isles while the other is hosted by the Denmark Strait.

VISIBILITY. In general, fog is both less frequent and less extensive in August then in June or July. Percentage frequencies of visibility less than 2 mi occur 10 percent or more of the time from the Cabot Strait, between Newfoundland and Nova Scotia, southeastward to south of the Grand Bank. From there, the line bends much as it did during July with the exception that fog is less frequent over the waters between Iceland and southern Greenland. The 20-percent area over the western ocean is now located only in the vicinity of the Grand Bank and the southern Labrador Basin. Over the extreme northeastern ocean, 20- to 30-percent frequencies of this low visibility are enclosed in an elliptically shaped area whose major axis runs from the northern Icelandic coast to about 73°N, near 5°W. A small area of visibility less than 2 mi exceeding 30 percent is centered near 68° N, 19°W.

NORTH PACIFIC, AUGUST

WEATHER. The mild weather of July continues over the North Pacific. The 2 mo are very similar except that in August fogginess decreases, typhoons and extratropical cyclones are more numerous, and temperatures reach their maximum for the year. By the middle of the month, the 1010-mb Aleutian Low has reappeared over the northern Bering Sea near 61°N, 178° W. The subtropical High (1025 mb) is centered near 38°N, 152°W in August.

WINDS. The prevailing wind pattern for August closely resembles that of July, except in the waters around Japan where winds tend to blow from the southeasterly quarter and over the Gulf of Alaska where the winds are now prevailing from the southwest. The average speed of the wind in August is force 3 to 4.

GALES, although unusual in areas not affected by tropical cyclones, do occur more than 5 percent of the time over the heart of the Bering Sea, along the easternmost capes of Kamchatka, and northwest of the Bering Strait. Owing to the influence of tropical cyclones, another small area of greater than 5-percent frequency is centered near 25°N, 134°E.

EXTRATROPICAL CYCLONES. The number of extratropical cyclones is slightly higher in August than in the preceding month. Most of these storms form off the coast of Japan and move northeastward into the Bering Sea. Others enter the Bering Sea after developing off the southeastern tip of Kamchatka; these storms often journey as far north as Kotzebue Sound. Still another primary cyclone track scampers toward the Gulf of Alaska from a point near 51°N, 158°W.

TROPICAL CYCLONES. The frequency of tropical cyclones in the western North Pacific reaches a peak in August and September. About five tropical storms can be expected in August; three or four reach typhoon intensity. Typhoons in August are displaced farther to the north than in July and have less of a tendency to pass directly over the northern Philippines. Some move directly toward Japan and Taiwan; others may pass over Japan after recurving over the Yellow Sea. Those storms that do enter the South China Sea usually move west-northwestward into the Gulf of Tonkin and North Vietnam.

Over tropical waters west of Mexico, four or five tropical storms usually occur--a maximum for any month. The average duration of these storms is 6 days, and about half attain hurricane intensity. As in July, cyclones usually move in a west-northwesterly direction out to sea where they almost always die after meeting colder waters and more stable air. Occasionally, however, one recurves before it has moved too far from the coast and moves inland over Baja California on the Mexican mainland.

SEA HEIGHTS. During August, sea heights of 12 ft or more are rare and occur less than 10 percent of the time across the entire North Pacific Ocean.

VISIBILITY improves slightly during August. Neither the 10-percent frequency line nor the 20-percent frequency line indicating visibility less than 2 mi extend as far south as they did during July. Both regions encompassed by the 30- and 40-percent frequency lines have shifted west-northwestward. Consequently, they both extend farther out over the Sea of Okhotsk. In addition, the total area within the 30-percent frequency line has shrunk so that its northeastern boundary reaches only as far as the Near Islands. Conditions over the Bering Sea are about the same as in July. If anything, the area between St. Lawrence Island and the Bering Strait is more foggy.

NORTH ATLANTIC, SEPTEMBER

WEATHER. With the approach of autumn, subdued weather conditions that characterize the summer season over the higher latitudes gradually give way to increased cyclonic activity resulting from moderate intrusions of colder air. The Icelandic Low deepens to about 1006 mb, and is centered roughly halfway between Iceland and southern Greenland. The Azores

High (1021 mb), centered near 33°N, 40°W, is a little weaker than in August.

WINDS. Almost without exception, the prevailing winds are westerly between 40° and 60° N. However, over the Grand Banks and the waters east of there to about 40° W. southerly winds prevail, and winds are variable south of Nova Scotia and over the Bay of Biscay. Speeds across this latitudinal belt are generally about force 4. South of 40°N, somewhat lighter winds average about force 3. Wind directions are frequently variable between 30° and 40°N, along the axis of the subtropical High, but northerlies dominate between 20° W and the Strait of Gibraltar. Between 30° and 10°N, easterly winds predominate over the western ocean (northeasterly over the Caribbean Sea) and northeasterly winds are the rule over eastern waters. Northwesterly winds blow over the Mediterranean, and southeasterlies are common over the extreme southern North Atlantic. Northerly winds prevail south of the Denmark Strait while southwesterlies predominate over the Norwegian Sea. Northwesterly and southeasterly winds are most common over the southern approaches to the Davis Strait. Wind speeds north of 60° N average force 4 east of Greenland, but near the Davis Strait more reports of force 2 winds are received than of any other speed group.

GALES. The frequency of gales increases in September, particularly over northern latitudes. Frequencies of 10 percent are found just south of Greenland's southern tip, over the open waters between northern Labrador-southern Baffin Island and southwestern Greenland, over the Norwegian Sea, and over the waters north and south of Iceland. The highest frequency, 20 percent, is found over waters well north of Iceland and over a portion of the Norwegian Sea. Elsewhere, 5-percent frequencies are fairly common north of 50° N. South of 40°N, gales are unlikely to be encountered except in storms of tropical origin.

EXTRATROPICAL CYCLONES are more frequent than in August, and occasional severe storms may be encountered. Primary storm tracks lead northeastward from the waters off Labrador and Newfoundland to southern Iceland and then over the Norwegian Sea. Another major storm track enters the Davis Strait from the Hudson Bay-northern Quebec region, while a third advances up the Baltic Sea from southern Scandinavia into Russia. One secondary storm track crosses the Straits of Mackinac on its way from the Great Plains to the primary track over Labrador.

TROPICAL CYCLONES. Tropical storm activity reaches a peak in September. From 1931-73, 143 tropical storms have originated in September, and 90 of these have reached hurricane intensity. As many as seven tropical storms were reported in September (1949), while in 1930 there were none. The entire western ocean is subject to these storms, many of which originate east of the West Indies and move westward over or north of these islands either to enter the Gulf of Mexico, or to recurve northeastward over western waters. Some storms entering the Gulf recurve over Florida and often parallel the U.S. east coast. Another breeding ground for tropical cyclones is over the Caribbean, east of Nicaragua. Many tropical storms or hurricanes are still packing considerable punch when they reach northern shipping routes.

SEA HEIGHTS of 12 ft or more have a frequency of 10 percent or higher over most of the North Atlantic between 50° and 65°N, while small areas of 20-percent frequency occur off Greenland's southern tip and over the Denmark Strait.

VISIBILITY. Percentage frequencies of visibility less than 2 mi exceed 10 percent north of a line drawn from the western Labrador Sea eastward to 57°N, 48°W, and then southwestward to encompass all of Newfoundland and the Grand Banks. From there, the line extends north-northeastward to the waters south of the Denmark Strait and then eastward, barely missing the southern tip of Iceland, before dipping southeastward to include the Pentland Firth and the Hebrides. The line then passes east of the Shetland Islands before entering the Norwegian Sea midway between Iceland and Norway. Percentage frequencies of visibility less than 2 mi decrease to less than 10 percent over the central and northern portions of the Davis Strait, but increase to more than 20 percent over the northern reaches of the Labrador Sea above 60°N, and over the waters north of Iceland, east of the Denmark Strait. Over a small portion of the latter area near 69°N, 16°W, the percentage frequency of visibility less than 2 mi exceeds 30 percent.

NORTH PACIFIC, SEPTEMBER

WEATHER over the North Pacific continues to be generally pleasant in early September but, as the month advances, early winter-type storms occur over the northern shipping lanes. Western portions of these routes are also subject to tropical cyclones. A closed Aleutian Low reappears in September, centered over southwest Alaska with a central pressure of 1007 mb. The 1021-mb subtropical High, near 36°N, 146°W, has weakened considerably and is centered about 300 mi southeast of its August location.

WINDS. The summer winds of July and August start to undergo modification in September. Between 40° and 60°N, westerly winds of force 4 prevail over the waters between 160° E and 150°W, but over the Bering Sea northwesterlies are predominant. East of 150°W, winds tend to blow more from a southwesterly direction except close to the coast of the conterminous United States where northerly winds are general and over the Gulf of Alaska where easterly winds prevail. West of 160°E, force 4 winds enter the area from the southwest. North of 60°N, northerly winds (force 4) are likely to be encountered. South of 40°N, force 3-4 winds are most common, and the "northeast trades" prevail over most of the waters between the Equator and about 35° N. Winds from the southerly quarter still predominate east of Honshu. Near the Asiatic 3 to 4 winds are most common, and the "northeast trades" prevail over most of the waters between the Equator and about 35° N. Winds from the southerly quarter still predominate east of Honshu. Near the Asiatic mainland, a change to the winter (northeast) monsoon is in progress except over the South China

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Sea and the waters east of the Philippines where southwesterlies still flourish. Out from the Gulf of Tehuantepec, winds are quite variable, although those from the southerly quarter are least likely to be observed.

GALES. Winds of 34 kt or higher are encountered between 5 and 10 percent of the time over much of the open Pacific north of about 45° to 50° N over eastern waters and between about 37° and 45° N over western waters. A typhoon-influenced area of frequencies greater than 5 percent extends from the East China Sea to the Philippine Sea.

EXTRATROPICAL CYCLONES. Well-developed extratropical storms occur more frequently in September than in August. Most of these move northeastward from the Japanese Islands to pass over southwestern Alaska. Others enter the Gulf of Alaska from the waters south of the eastern Aleutians. Storm tracks are displaced southeastward from those of August.

TROPICAL CYCLONES. On the average, four or five tropical storms can be expected in the western North Pacific in September, almost as many as in August. About three of these will achieve typhoon strength. These storms usually originate in the lower latitudes west of about 150°E, and initially move west-northwestward. Some travel across the northern Philippines and the South China Sea, while others recurve in the vicinity of the Philippine Sea to pass over or near the Japanese Islands.

About three tropical storms will whirl off the Mexican coast in any given September. One or sometimes two will usually become a hurricane. These storms either originate over the waters off southern Mexico and move northwestward parallel to the coast (and sometimes inland), or they develop near the Revillagigedo Islands and move westward out over the open ocean.

SEA HEIGHTS of 12 ft or more are common 2 to 10 percent of the time north of about 35° N over eastern waters and north of about 30° N over western waters (excluding the Bering Sea)--as well as over the South and East China Seas, the Gulf of Tehuantepec, and the lower Gulf of California. Two areas of maximum frequency greater than 10 percent are located within an elliptically shaped area between 46° and 50° N and 162° and 179°E, and over the Okhotsk Basin.

VISIBILITY. Fog is less prevalent in September than in August, but it is still frequent north of about 40° N. Frequencies of 10 percent or more of visibility less than 2 mi are common over the waters between 40°N and the Bering Strait, west of 145° W and east of 150° E. However, the Alaska Peninsula and the Gulf of Alaska, included within the above area, host frequencies of less than 10 percent. A region of frequencies greater than 20 percent surrounds the waters of southern Kamchatka southwestward to the central Kurils, then eastward to Ostrov Beringa.

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